MODERN
Machine Shop
$2.00
Per Year
June, 1929

Our First Birthday

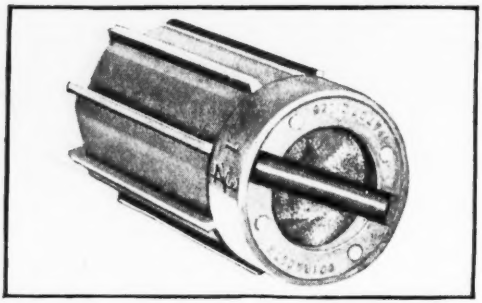
ONE year ago MODERN MACHINE SHOP entered the metal-working field to provide a service for the exchange and dissemination of technical information to the mechanical executives of this great industry, bespeaking the support and co-operation of our readers.

That the need for such service existed is evidenced by the enthusiasm with which our advent into the field was received. The growth of this magazine during the first year of its existence has been without precedent, and we thank each and every one of our readers for this wonderful support.

HOWARD CAMPBELL,
Editor.

A Shop Practice Magazine

The Arbor Broke



PROVING THE STRENGTH AND ENDURANCE OF CONRADSON REAMERS

THIS tool was forced to a point where the strain was so great that something had to break. And—the arbor broke. Close inspection showed a perfect structure—no crystalization—no fracture. But, the Conradson Inserted Blade Reamer stood the punishment and could be put into work again.

The rigid construction and advanced design of Conradson Reamers are responsible for their remarkable performance. Don't delay taking advantage of this economy. **CONRADSON REAMERS COST FROM 25 PER CENT to 40 PER CENT LESS.**

CONRADSON TOOL CORP.

(Tool Division of Simonds Co.)

2116 INDIANA AVENUE CHICAGO, ILLINOIS

CONRADSON TOOL CORP., 2116 Indiana Ave., Chicago, Ill.
Send latest Conradson Catalog and prices on reamers.

Firm ..... Name.....

Address .....

E Engineering 10-25-45

MODERN
Machine Shop

A MAGAZINE FOR MACHINE SHOP EXECUTIVES
Published monthly at 128 Opera Place, Cincinnati, Ohio
DON G. GARDNER, *Publisher and Gen. Mgr.* HOWARD CAMPBELL, *Editor.*

Vol. 2 JUNE, 1929 No. 1

CONTENTS

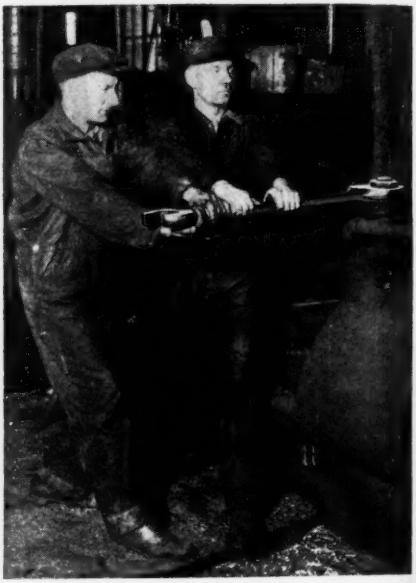
Page

THE USE OF THE X-RAY FOR METAL PARTS INSPECTION 9
By E. W. Page
SPECIALIZING ON DIE WORK HAS BUILT THIS BUSINESS 12
By Howard Campbell
MEASURING AND REDUCING LABOR TURNOVER—*By J. J. Berliner* 22
MACHINING PARTS FOR TUTHILL PUMPS—*By Donald A. Clark* 32
ENCOURAGING GOOD WORK—*By Russell J. Waldo* 42
THE NATURE AND PROPERTIES OF IRON AND STEEL. VI 44
By George M. Enos
"FIRST AID" TABLE FOR DRILL PRESS OPERATORS 58
IDEAS FROM READERS 62
—ELIMINATING BEARING PRESSURE ON SHORT BELT DRIVES, *By R. H. Kasper*
—CALIPER GAGE FOR LAYING OFF DRIVING BOX BRASSES, *By H. H. Henson*
—SIMPLE METHOD OF CHECKING FURNACE TEMPERATURES, *By R. H. Kasper*
—TWO HANDY BORING TOOLS, *By J. H. Hahn*
—ADJUSTMENT FOR ROLLING TOOL, *By Jos. C. Coyle*
EDITORIALS 66
NEW SHOP EQUIPMENT 68
"INFORMATION WANTED" CHECKING PAGE 90
FOR YOUR CATALOG LIBRARY 92
RIFF RAFF RAVINGS 100
INDEX TO ADVERTISEMENTS 102

Guaranteed circulation this issue, 26,750 copies, certified by U. S. Post Office receipts.

(Copyright 1929 by Don G. Gardner, Publisher)

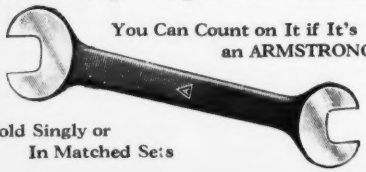
ARMSTRONG Drop Forged Wrenches have been the Standard of Excellence for over 20 years



No matter what the job, there's an ARMSTRONG Wrench to do it.

WITH over 29 patterns and as many as 68 sizes of a single pattern, there are ARMSTRONG Drop Forged Wrenches for all uses. ARMSTRONG Wrenches are provided with accurately milled openings for all standard bolts, nuts and screws. Special millings are available with excellent delivery.

Though of many types, ARMSTRONG WRENCHES are of one quality—the best that can be made. Designs and proportions are based on practical knowledge of wrench requirements—a knowledge gained thru over 37 years of fine tool making. Forged from selected steel that gives both stiffness and tensile strength, these trim, balanced wrenches are uniformly dependable.



You Can Count on It if It's an ARMSTRONG

Sold Singly or In Matched Sets

Armstrong Bros. Tool Co.

"The Tool Holder People"

328 N. Francisco Ave., Chicago, U. S. A.

ARMSTRONG

TRADE MARK REG. IN U.S. PAT. OFFICE

"ARMSTRONG"

Tool Holders
Lathe Dogs
"C" Clamps
Drop Forged Wrenches
Ratchet Drills
High Speed Tool Bits

Write today for Catalog B 27

"ARMSTRONG BROS."

Stocks and Dies
Chain Pipe Tongs
All Steel Pipe Wrenches
Pipe Cutter
Hinged Vise
Chain Vise

MODERN
Machine Shop

JUNE, 1929

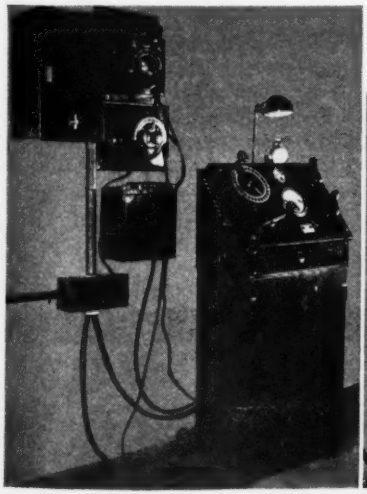
CINCINNATI, OHIO VOL. 2, NO. 1

The Use of the X-Ray for Metal Parts Inspection

By E. W. PAGE
Victor X-Ray Corporation, Chicago.

WHILE the general public has long been aware of the value of the X-Ray for medical and other scientific uses, very few know that X-Rays are also being utilized for industrial purposes such as the examination of objects fabricated from metal, clay, cloth, and other materials, and for other purposes where the materials involved are opaque to normal vision. In some cases, materials that are transparent to ordinary light present an optical illusion, making it impossible to ascertain the exact condition of the material without the use of the X-Ray.

Casting methods are, in most cases, practically the same as they were many years ago, and while equipment for melting, pouring and measuring temperatures have been developed, determination of the condition of the finished piece has been confined to such examination as could be made



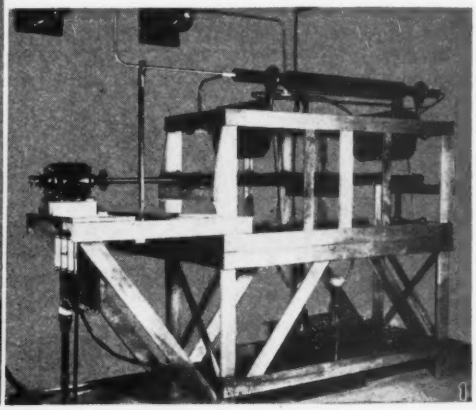


Fig. 1—(Left) Control Equipment for an Industrial X-Ray Machine. (Below) Type of Modern X-Ray Machine Used for Industrial Purposes.

by the use of the five senses. The inspector is doing the best he can with the aid of his natural means, passing material when he cannot discover flaws, and rejecting material when flaws are detected by the use of the eye or ear. But often materials that have been passed as sound reveal defects after expensive machining operations have been performed on them, or after they have been put into service. In either case, all labor that has been put on the piece is wasted.

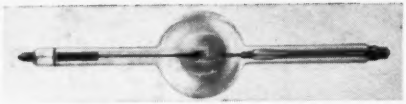


Fig. 2—Coolidge X-Ray Tube.

The development of the X-Ray has given industry another—and valuable—tool with which to work, and a number of plants have installed equipment with which the condition of the interior of a casting can be determined before it is sent to the machine shop. The operation consists of taking an X-Ray picture or "radiograph" of the casting, which is done by passing the X-Rays through the object and on through a photographic plate. The denseness of the image cast on the plate is governed by the thickness and density of the object, consequently thick sections show up much darker than the surrounding shadow, while thin sections and blow-holes are much lighter. A machine of the type that is most commonly used for industrial purposes is illustrated in Figure 1.

The equipment and materials required for making radiographs are too expensive to allow the use of this process for inspecting parts that are so small or unimportant that the expense of rejections offsets the expense of examination, but for expensive castings, castings that form a part of a complicated mechanism where the assembling cost is high, or where failure in service may result in the loss of human life, the cost of X-Ray inspection is relatively low and, in the latter case, cannot be considered.

The operation of taking an X-Ray photograph is very simple, consisting of placing the photographic film in a holder, which is known as a "cassette," laying the object to be photographed on this cassette on a platform beneath the X-Ray tube, and applying the X-Ray for a predetermined length of time. In order to confine the rays to the area in which they are to be used, the tube is enclosed in a lead box with an opening in the bottom through which the rays can pass to the object. X-Rays will not pass through lead.

If the material is of high atomic weight, such as copper, brass, or similar metals, the operation of mak-

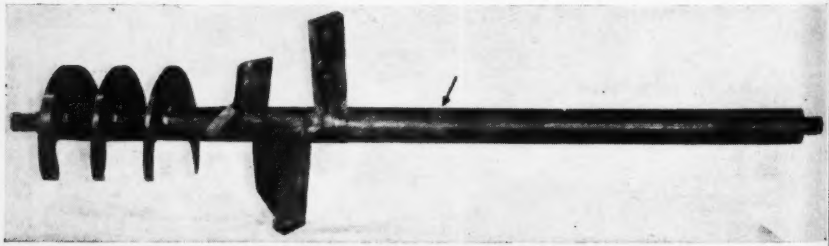


Fig. 3—Machine Part, 4 Feet Long, Made of Bronze.

ing a radiograph will require a somewhat longer amount of time than would be required if the material is iron or steel, the atomic weight of

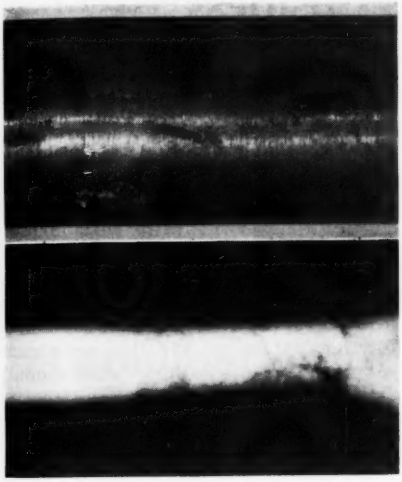


Fig. 4—(Above) Section of Machine Part, Showing Defect. (Below) Radiograph of Defective Section. The Defect Extends for Three Inches Inside the Casting.

which is much lower. The atomic weight of aluminum being much less than that of either of the metals mentioned, a correspondingly shorter amount of time is required. The rays will pass through 3½ inches of carbon steel in thirty minutes, and will pass through a similar section of aluminum in a few seconds. Greater thicknesses of the lighter metals can be radiographed in less time than is required for thinner sections of the heavier metals. The film must be as large as the object or section that is to be radiographed, as a radiograph is merely a shadow picture, and the image produced on the plate is actual size.

Figure 3 shows an important part of a machine, made of bronze. It is evident that the amount of work that has been put on this piece to finish it as shown has been considerable. In the turning operation on the shaft, which is two inches in diameter, a small defect has been uncovered. The question naturally arises as to whether the imperfection extends only as far as it is visible, in which case it is amply strong enough to be used, or whether the defect extends far enough into the shaft to weaken it to such a point that it is unfit for use.

A close-up view of the section containing the defect is shown in the upper illustration, Fig. 4, and a radiograph of the section, taken at closer range, is shown in the lower illustration. It is apparent from the radiograph that the visible part of the imperfection is the least of the trouble; the really serious part of the defect is located at least three inches beyond the visible imperfection.

A radiograph of a copper casting in which two bad blow-holes are located is reproduced in Fig. 5. On this casting, also, a considerable amount of machining has been done

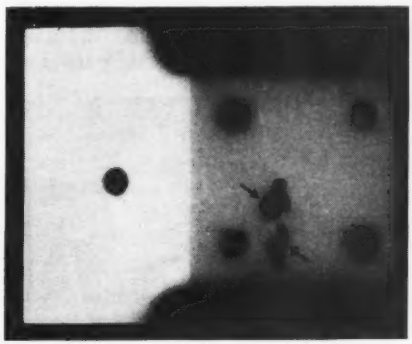


Fig. 5—Radiograph of Copper Casting, Showing Defects in Interior.

before the defects indicated by the arrows were revealed. The cost of a radiograph would have been much

(Continued on page 64)

Specializing on Die Work Has Built This Business

By HOWARD CAMPBELL

BY specializing on one class of work and doing that work well, the Modern Tool Company, Cincinnati, Ohio, has developed a service which is fully appreciated by users of dies in that vicinity. This firm has been making tools and dies for some thirteen years, during the first eight of which a general tool-making business was conducted and any job of tool, jig or die making that was offered was accepted. Die work predominated, however, probably because the two owners of the business—Ed Gardner and H. C. Murrer—were both expert die makers, and as the orders for dies continued to grow, it became more and more apparent that there was a tremendous field for die work alone for the firm who could offer a really first-class service.

The final result was that the working force and equipment were reorganized to concentrate on die work, and all other orders were rejected. The little crew of four men who composed the organization five years ago has grown to twenty-five men, and the business is growing with increasing speed. An expert knowledge of design as applied to dies for high production has been the magnet that has drawn repeat orders from 75 per cent of the customers, and this percentage of the business done each month comes either from old customers or from others whom the old customers have sent in.

Eighty per cent of the business handled by this shop is taken on a cost-plus basis, and this system of remuneration, although not insisted upon, is recommended to all customers. While the shop, because of its highly skilled and specialized organization and first-class equipment, can compete fairly with others on a

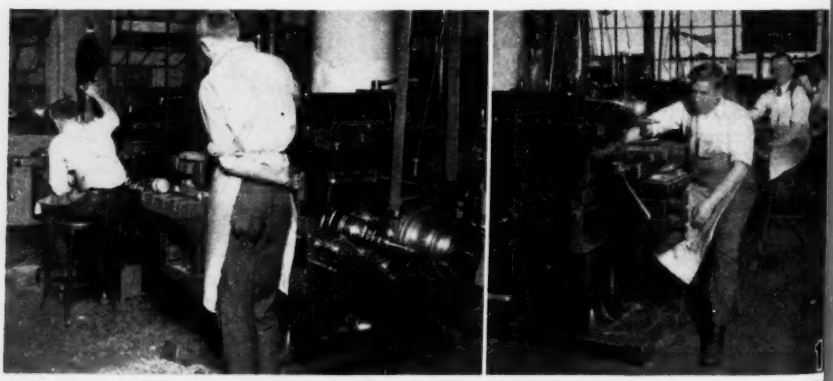
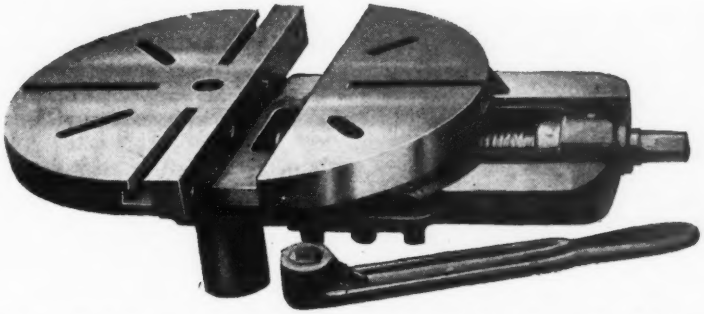


Fig. 1—These five Smith & Mills shapers are accurate and fast.

FREE TRIAL OFFER



Combination Drill Table and Vise

A Safety Tool That Saves Its Cost In Labor Alone Every Six Months

A 40-minute set up—the old way. One minute with the "Combination."

You pay for the Combination Drill Table and Vise whether you have it or not. Take advantage of our offer. Try it in your shop for 30 days. If it doesn't sell itself, send it back and we'll pay transportation both ways. Nothing could be more fair. Just mail the coupon below.

Mail This Coupon

MODERN MACHINE TOOL CO.
Jackson, Michigan

We would like to try the Combination Drill Table and Vise in our shop for 30 days as you offer. No obligation, of course.

Name.....

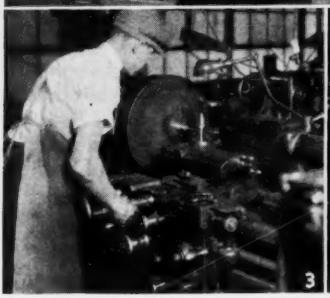
Address.....

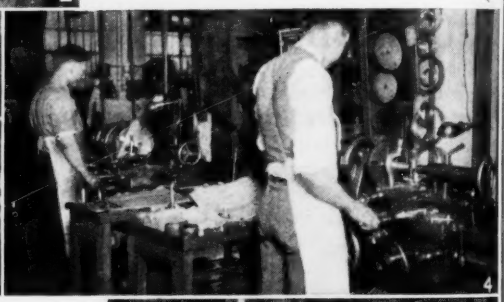
MMS-6129

MODERN MACHINE TOOL COMPANY

JACKSON, MICHIGAN

flat price basis, an effort is made to turn out the finest piece of work possible in each instance, and it has been demonstrated again and again that a die designer who is unhampered by a matter of a few dollars will turn out a die that will more than justify any extra cost which may be incurred.





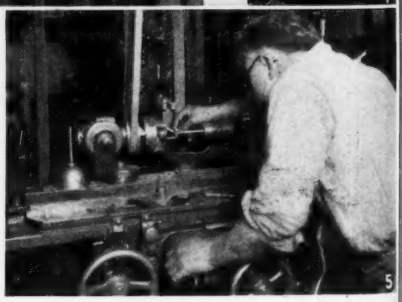
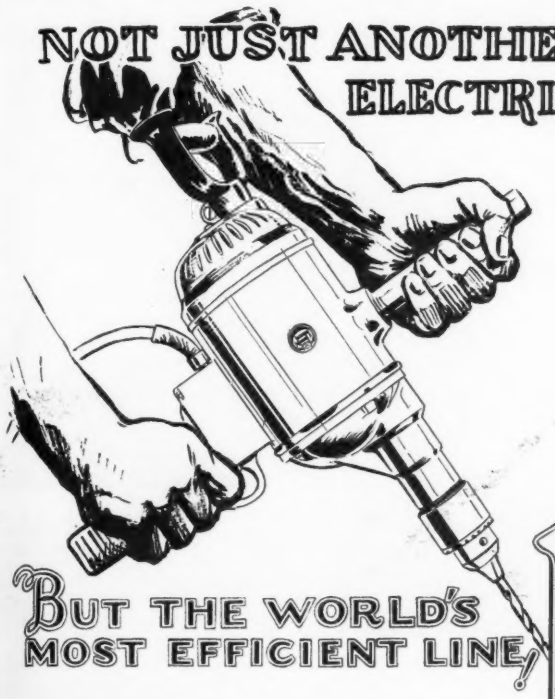


Fig. 2—Larger die plates are machined on the planer. Fig. 3—Using a Bradford lathe to turn a bushing for a compound blanking, piercing and drawing die. Fig. 4—The mechanic at the left is facing a die plate; the other is turning a mandrel for a special job. Fig. 5—This Oesterlein grinder is used for internal grinding.

For example, in the interim between the time that a bid is made on a "flat price" job and the time that the order is actually received, the designer may develop a new idea for a die which, although costing, perhaps, a few dollars more, would turn out vastly more or better work. Or, as frequently happens, a new idea may present itself after the order has been taken and while the designer is developing the design. If the designer were held to a flat price, he might be unable to incorporate the new idea, whereas, on a cost-plus basis of remuneration, he is able to give the customer the best die possible. That this system is proving satisfactory is evidenced by the fact that when a die has once been made for a customer on a cost-plus basis, he rarely ever goes back to the flat-price method of payment.

The class of work that comes into this shop is highly diversified, ranging from the finest of clock work to ovens and other stove parts. The shop equipment has been selected to fill two requirements—lowest production costs and highest quality—and no tool or machine is omitted that can contribute to these important factors. In fact, a new Brown & Sharpe

NOT JUST ANOTHER LINE OF ELECTRICAL TOOLS



BUT THE WORLD'S MOST EFFICIENT LINE!

THIS claim has been made by thousands of mechanics and shop men, who are only interested in performance and results. Such concerns as General Motors Corp., Western Union Telegraph Co., U. S. Steel Corp., National Cash Register Co., and hundreds of other industrial leaders testify to the quality of "The Cincinnati" tools by buying them year after year.

Builders of

The Cincinnati

Ball Bearing Electric Drills, Screw Drivers, Nut Setters, Tappers, Valve Grinders, Aerial Grinders, Tool Post Grinders, Floor Buffers, Bench and Floor Grinders.

For any job that calls for electric drills, grinders, buffers, etc., there is a tool in "The Cincinnati" line that has proven its ability to do better and quicker work.

For a copy of our complete new catalog, send the coupon at once.

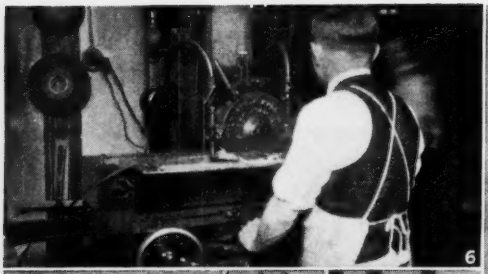
THE CINCINNATI ELECTRICAL TOOL CO., Cincinnati, Ohio

Please send me a copy of "The Cincinnati" complete new catalog.

Firm Name _____

Address _____

Attention of _____ Title _____



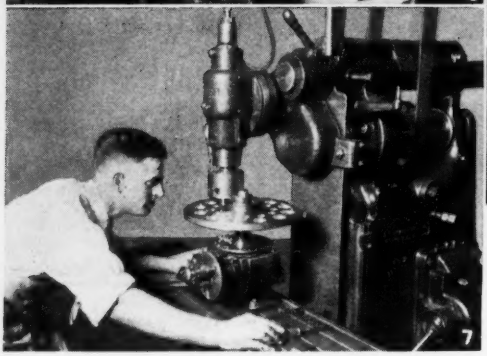


Fig. 6—Grinding the surface of a die stripper plate. Fig. 7—Using a Brown & Sharpe milling machine with vertical attachment to bore holes in a rotary feed plate for a forming die. Fig. 8—Sawing hole in die to make metal struts for aluminum pistons.

surface grinder has just been purchased to take care of one order.

There is no question but that concentration on die work has resulted in better work than was possible when the energies of the organization were divided, and the machinery, tools, handling equipment, heat treating department and recording system have been selected or developed with one objective. The heat treatment is considered the most important operation in the making of a die because, as Mr. Murrer says, "All the work that has been put on a die is lost if the die is not properly heat-treated."

In order to eliminate all guesswork and to determine exactly what could be expected from the different kinds of steel under the various conditions of heat treatment, some 200 specimens of steel were hardened, drawn, and tested. A record was made of each specimen so that, when designing a die, the designer can make sure that the die will be properly hardened by specifying the kind of steel to be used and the heat treatment to be applied.

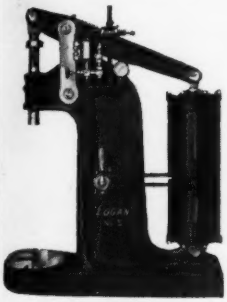
Thus the heat treatment is established at the time the die is designed, and a record is kept so that if the die does not perform satisfactorily, or in accordance with the designer's expectations, the heat treatment on future dies of the same type can be varied to suit. The result is that the quality of the product is being constantly improved, where possible, and dies which would have been considered entirely satisfactory a few years ago are as extinct as the dodo bird, in so far as this shop is concerned. For example, a company manufacturing curtain rollers was using, five years ago, a set of eight dies that would produce fifteen gross of rollers per day. The Modern Tool Company designed and built a set that is producing 150 gross of rollers per day with

THE CHEAPEST LABOR ON EARTH IS

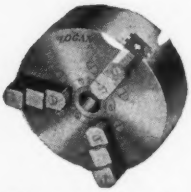
-air-

Reduce Costs
Save Labor
Increase Production

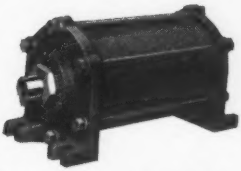
With "LOGAN" Air Operated DEVICES



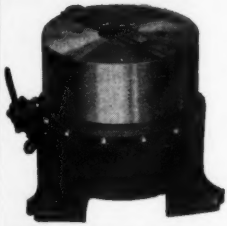
Arbor Presses



Three Jaw Chucks



Non-Rotating Cylinders



All "LOGAN" Chucks are adaptable for Drill Press and Assembly Work.

WHERE economical production is a factor, LOGAN quick-loading work holding devices are necessary equipment.

Made in the largest plant in the world, devoted exclusively to the manufacture of air-operated equipment, these tools will be found thoroughly dependable and efficient.

Ask for catalog of LOGAN air-operated devices. Copy free to any machine shop executive.

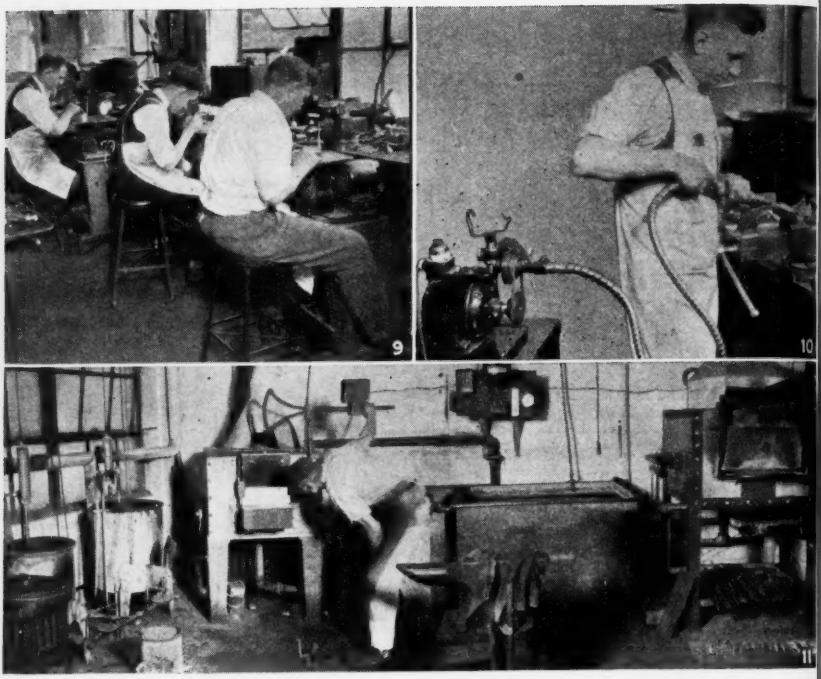


Fig. 9—The filing is done with these three Oliver machines. Fig. 10—Using a Strand flexible shaft and routing tool to finish a forming die. Fig. 11—The heat treat department. The temperature of each furnace and tempering bath is automatically controlled.

no increase in labor cost. And the new dies last four times as long as the old ones did.

The operating force in this plant consists of specialists; any machine work required is done by machine hands, who turn the parts over to the die makers. The die maker is not responsible for the work done by the machinist, but he is responsible if he accepts a part that is not up to specifications. A battery of Smith & Mills shapers of various sizes provides for the machining of flat surfaces on the smaller parts, and a small planer takes care of the larger parts. Five of the shapers are shown in Fig. 1, and the planer is shown in action in Fig. 2.

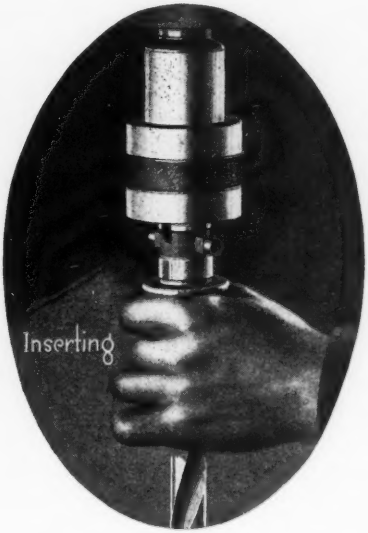
The machinist shown in Fig. 3 is boring out a bushing; the mechanic at the left in Fig. 4 is facing a die plate for a die for a lamp part, and the operator at the right in the same illustration is turning a mandrel for a special job. Fig. 5 shows the operation of grinding a hole in a guide bushing, for which an Oesterlein internal grinding machine is used. Work on this machine is easily held to a limit of .00025 inch.

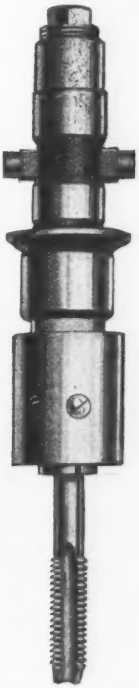
The surfaces of die stripper plates and other similar parts are finished on the Wilmarth & Mormon surface grinder, shown in Fig. 6. A Brown & Sharpe milling machine equipped with a vertical attachment, Fig. 7, is

McCrosky WIZARD Chuck

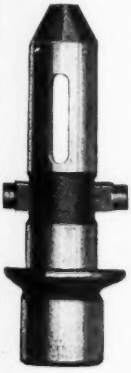
McCrosky COST CUTTING TOOLS

WIZARD Quick Change Chucks and Collets





Friction-Drive Tapping Collet

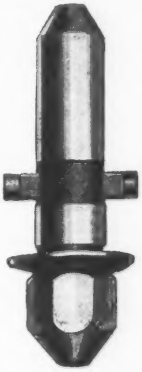


For Morse Taper Shank Tools

WITH a WIZARD outfit you can change tools without stopping the spindle. WIZARD Chucks hold tools rigid and perfectly centered. There's a WIZARD Collet for every tool you use. *Bulletin No. 11-B* will show you the outfit for your job. Send for a copy.

McCrosky Tool Corporation
MEADVILLE, PA.

Branches in Cleveland, Detroit, Chicago, and Toronto. Agencies in all other principal cities.



For Straight Shank Tools

used for fine boring jobs. The piece shown on the machine in this illustration is a rotary feed plate for a forming die for a window shade ferrule. The piece is bolted to a dividing head, and a Flynn boring head is used to hold the tool. This head is graduated in thousandths of an inch, but the mechanic is finding no difficulty in splitting the thousandths on this operation.

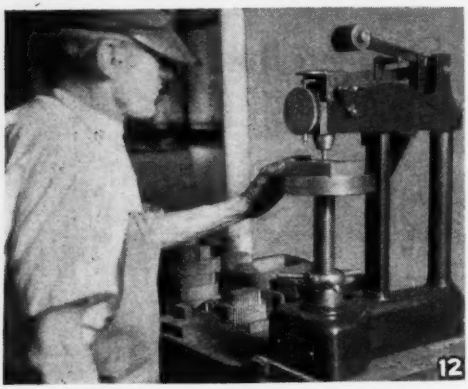


Fig. 12—Each die is tested for hardness after heat treatment.

Another fine piece of equipment is the Marburg "Thiel" die-sawing and filing machine shown in operation in Fig. 8. Although intended for both sawing and filing, the machine is so rigid that it is used mostly for sawing, the filing operations being handled on lighter "Oliver" die-making machines. Three of the filing machines are illustrated in Fig. 9.

A Strand flexible shaft outfit is shown in operation in Fig. 10, where a die maker can be seen using the machine with a routing tool to rout out a hollow in a die that is to be used for forming an odd-shaped elbow for an oil measure.

Two gas-fired heat treating furnaces, two tempering baths, and the necessary water and oil quenching tanks are shown in Fig. 11. Automatic control is provided for both the

(Continued on page 40)

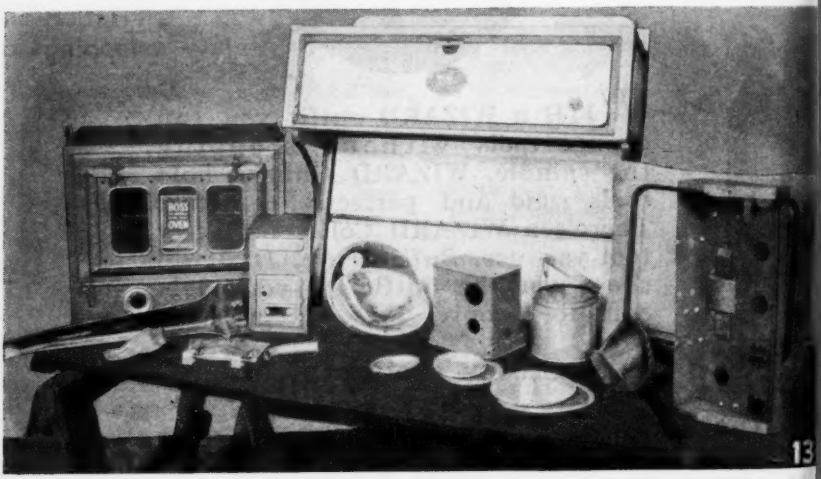


Fig. 13—Samples of some of the work that has been turned out with dies made by the Modern Tool Company.

No. 191
No. 168
No. 368
No. 6
No. 2 R
No. 1042
Tools of Real Quality
Not necessarily more costly, but tools that sell at a price that will permit real steel to be used—proper, scientific heat treating done and finished as real mechanics like to have their tools finished.
We have over 1,500 of 'em from which to choose, and all leading jobbers and dealers carry them in stock.
Send for your copy of "Handbook of 1,500 Good Tools." It's free!
GOODELL-PRATT COMPANY
Greenfield, Mass., U. S. A.
GOODELL PRATT
1500 GOOD TOOLS

Measuring and Reducing Labor Turnover

By J. J. BERLINER, B. C. S.
Senior Member of The National Accounting Systems

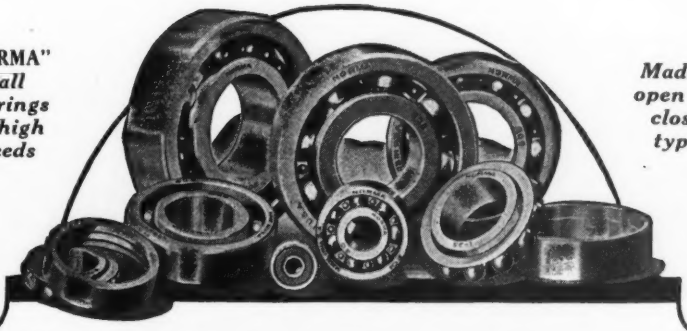
LABOR turnover may be defined as the mobility existing in the working force of an organization. It is the shifting in the labor force which results from the fact that for many reasons, men leave their jobs. In short, every employee who leaves the employ of a given establishment—no matter what the reason be—constitutes a part in the turnover of that concern. A study of labor turnover involves an analysis of the causes and effects of men leaving their employment, and the development of means of preventing such terminations as may be unnecessary and undesirable.

Labor turnover is measured in terms of the proportion of those who terminate their employment in a definite period of time—usually one year is the assumption, unless otherwise stated—to the average number who have been on the active payroll during the same period. In other words, dividing the number of men who leave by the number of the total working for the same period of time gives the ratio of labor turnover.

However, it must be noted here that there is by no means complete agreement as to what turnover is and how it ought to be measured. There is a second method of considering it which is based primarily upon the principle of replacement and which views turnover as occurring only when the cycle has been completed from the hiring of a worker to the hiring of his successor when he leaves. According to this method, the percentage of labor turnover for any given period is derived by taking the total replacements for the period considered and dividing by the average number on the payroll. Undoubtedly there are many favorable points for this method. The most essential one is the fact that it indicates the success with which the needed working force is being maintained and the needed amount of production being turned out. It assumes, however, that there exists a standardization of the plant's production in terms of each worker's day's work and of a standard total day's output of the plant—and these are conditions which are frequently lacking, because the necessary degree of control over the volume of production can only begin to be obtained by scientifically managed plants. It is only where standard performance is known that there is a basis of comparison between expected and actual production.

For practical purposes the first method, namely, that based on the ratio of those who terminate their employment to the total working force, is still valuable. Measuring turnover of labor by this yardstick has this advantage: it focuses attention on the individual worker who leaves; and it is the individual worker in whom, from the viewpoint of analysis and diagnosis of labor troubles, interest is centered. In short, the turnover of labor is not something to be considered by itself, to be measured and

"NORMA" *Ball Bearings for high speeds*



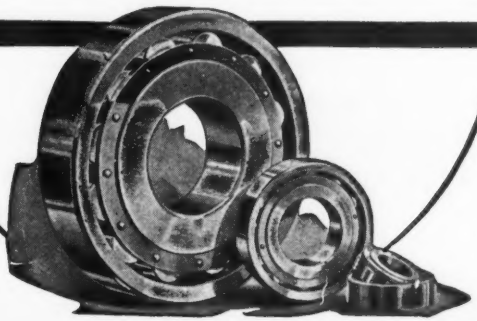
Made in open and closed types

The small added cost required to equip your machines with

NORMA-HOFFMANN PRECISION BEARINGS

will be returned a hundred times in better performance, longer life, and lower upkeep costs. Let our engineers assist you in selecting the right bearing and installing it correctly.

Norma-Hoffmann Bearings Corp'n
Stamford, Conn., U.S.A.



"HOFFMANN" *Roller Bearings for heavy duty*

In sizes interchangeable with ball bearings

discussed only in relation to a standard output. To be sure, it has a close effect upon output, but labor turnover, properly conceived, is rather a symptom than a disease, and like all symptoms, it is of interest to the practical person only in so far as it indicates the nature of the causes of maladjustment, and thus leads to corrective measures.

Workers usually leave a job because of dissatisfaction, and the effort from the administrative point of view must be to discover the source of that dissatisfaction. If all the workers in either a department or in a whole plant go out at once, the event is spoken of as a strike, and the board of directors at once inquires of the manager as to the reason for it and the nature of the men's demands. Indeed, the management may be severely censured for letting an interruption of work occur, but the management does not always so readily see that labor turnover—or the largest single part of it—is simply a strike by erosion, about which they should also be greatly concerned. Labor turnover amounts to a small but continuous strike which is gradually wearing away the working force one at a time, due to some cause which remains undiscovered, because an adequate channel of communication or adjustment is not provided. It is exactly as important to find the cause and meet the demand, when it is a just one, as it is in the case of a strike.

Formula of Labor Turnover—Reduced to its simplest terms, the formula for the determination of labor turnover would be:

T (Turnover)=
S (Total Separations)
F (Average force on payroll)

As it stands, however, this formula is too simple to disclose much about the meaning of the figures of separation. Some modifications in the method of computation are essential. Hence it is urged that the figures of workers leaving be itemized in ways that give them significance. An initial division usefully may be made between resignations, discharges, layoffs, and separations for health reasons. Under one of these headings each departure may be classified.

The figure **F** may be calculated in several ways; but perhaps as simple a method as any is to use the total weekly payroll figure of the departments in question. If the average force for a year is sought, these fifty-two amounts may be added and divided by fifty-two to give a yearly average. If the figures represented by **S** are obtained in terms of a week, in order to get the standard labor turnover figure, **T** should be multiplied by fifty-two; although the resulting figure will mean only that the turnover for that week was at the rate of such and such a per cent per year. When, however, fifty-two consecutive actual weekly percentages are available, the total of those fifty-two will give the actual yearly turnover.

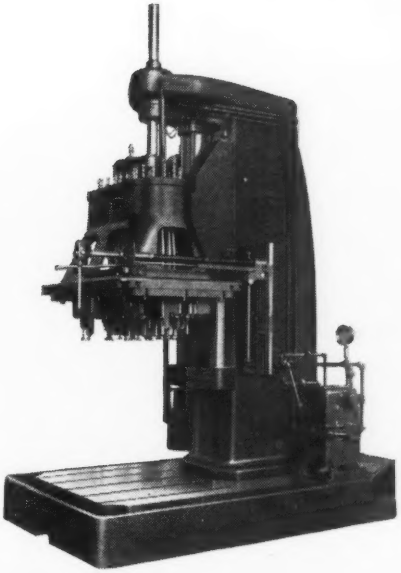
In order to obtain a detailed analysis of the reasons why employees leave their jobs, it is well to list the complaints under your major headings, with several sub-headings. The following arrangement is suggested, with clear recognition of the revision that it will require as it is used in specific instances.

1. Resignations: (a) Better job. (b) Dissatisfaction with wages. (c) Dissatisfaction with work. (d) Unable to get along with superior. (e) Leaving city. (f) Change of vocation.

2. Discharges: (a) Careless. (b) Incompetent. (c) Unreliable or irregular. (d) Insubordination. (e) Liquor. (f) Misconduct. (g) Dishonesty. (h) Trouble-breeder.

NATCO

C16H
HEAVY
DUTY



NATCO HYDRAULIC MULTIPLE DRILLER

The above illustration shows a Natco C16H Heavy Duty Hydraulic Multiple Spindle Driller designed for production drilling of large holes. The entire machine is unusually rugged in construction, cascade lubrication and frictionless bearings being used to insure long life with little attention.

The hydraulic feed is semi-automatic and the pressure is supplied by an Oilgear pump. Pulling the starting lever starts the head traveling forward rapidly. It automatically drops into power feed, drills to correct depth and then into rapid reverse and stops.

NATCO PRODUCTS

Standard Adj. Multiple Drills
Fixed Center Multiple Drills
Single Purpose Automatic Drills
Hi-Duty Single Spindle Drills
Drillers and Tappers
Special Machines

"NATCO Solves Your 'Hole' Problem"

THE NATIONAL AUTOMATIC TOOL CO.
RICHMOND, INDIANA, U. S. A.

3. Layoffs: (a) Decreasing force. (b) Lack of work.

4. Physical reasons: (a) Ill-health. (b) Injured. (c) Died.

In addition, a separate record should be kept marking each departure as avoidable or unavoidable. This distinction in many cases will be difficult to make, as for instance "unable to get along with superior," when given as a reason by a worker of conspicuous emotional instability, is an unavoidable resignation. There is, however, the possibility of the fault lying with the superior, and if so it is clearly an avoidable separation for which some remedy should immediately be devised.

Any wide agreement as to which causes for leaving are avoidable or unavoidable will undoubtedly be difficult to secure; but wide agreement is not so much needed at first as agreement of all concerned in one plant to keep its own figures consistently on the same basis over a period of years so that they are valid for purposes of comparison. For after all, their major purpose is to reflect from time to time the success of the management in reducing avoidable causes of dissatisfaction.

Of course, there are no limits to the refinements that can be made in the turnover figures. For example, complications due to the permanent reduction or the permanent increase of the working force during the period in which the amount of turnover is sought have occasionally to be met. In the interest of emphasizing the main idea of analyzing the remediable causes of dissatisfaction, no further modifications in formula or in the forms for recording it are suggested.

Figures showing the gross turnover of labor do not, however, necessarily indicate a great deal. The more itemized and localized they may be, the more significant they become. For example, turnover records when presented by departmental divisions often show one or two departments to be the principal causes of high turnover; and when kept by rooms or machines they may indicate that it is one particular operation or one foreman who is causing much of the trouble. In like manner, the segregation of turnover by sex, by age, and by wage groups may reveal discrepancies in company procedure that will otherwise remain unsuspected. In short, the purpose of any labor turnover compilations should be not to cover blank forms with figures, but to show where disaffection exists, why it exists, and how much of it may be eliminated.

There is considerable value, also, in figures which show the length of employment of workers who leave. If, as is often the case, the greatest turnover comes within the first six months of employment, it is likely to argue some deficiency in methods of selection or training. If it comes from workers of long standing, then it may indicate little opportunity for advancement in wages or in class of work. When carefully scrutinized, facts about length of employment of those who leave are likely to be very enlightening.

The above discussion is, of course, based on the assumption that the company has accurately discovered the reason of each individual's leaving. Indeed, the absence of a centralized employment office through which all leavers are required to report, makes the chances of getting the true causes for leaving very slim. Workers usually will not or do not tell foremen or timekeepers the real reasons for leaving. But the chances of accurate analysis are greatly increased if some tactful person in the employment manager's office is required to spend several minutes in

FORMICA GEARS

THE large Formica gear on this punching machine at the Scullin Steel Company in St. Louis was installed by the Turley Gear & Machine Company of St. Louis.

Formica gear cutters in every part of the country carry Formica sheets in stock from which gear blanks can be quickly sawed and gears of any size promptly delivered.

THE FORMICA INSULATION CO.
4632 Spring Grove Avenue
CINCINNATI OHIO

FORMICA

discussing, in private interview with the worker, his reason for leaving.

One thing to be cautioned against is the danger that the interviewer will put into the departing worker's mouth some reason which the worker will immediately take up and repeat back without ever disclosing what is really on his mind. This can be prevented if the employment manager is impressed with the fact that the man who is leaving is doing so because he is dissatisfied with some aspect of the company's labor policy; and considers it of first importance that his uncolored testimony be secured.

Although labor turnover is not a matter to be dealt with independently, its costs may to an approximate degree be figured separately, and a compilation of the turnover costs for a given job, department, or plant may be exceedingly useful as providing a good argument for changes and improvements. Such costs cannot, of course, be computed with perfect accuracy, but enough of the items may be segregated or closely estimated to present a conservative statement of the losses in production and in indirect expense due to high turnover.

The following is a list of items of cost which is illustrative if not exhaustive, as showing the charges involved in labor turnover that are not ordinarily taken into account. These costs may be roughly divided into overhead costs and operating costs.

Among the overhead costs are:

1. More rapid depreciation of machinery because of ignorance or lack of skill of new workers.

2. Extra floor space and extra machines to provide against decrease in production due to shifting labor.

Operating costs may include any or all of the following:

1. (a) Time spent by foreman or superintendent in discharging a worker where that is the manner in which the vacancy occurred. (b) Time spent by foreman or other workers in training the new employee. (c) Time spent by clerks on additional payroll or other records.

2. Machine costs, covering: (a) Time machinery is idle when a new worker cannot be obtained immediately. (b) Idle machinery for temporary stoppages due to ignorance or lack of skill of new worker. (c) Repairs to machines or renewals of tools broken for the same reason.

3. Material costs, including: (a) Wasted or damaged material due to ignorance or lack of skill of new worker. (b) Difficulties in subsequent operations or processes due to poor work by new employees on previous operations. (c) Lower production while new employee is working up to his best skill.

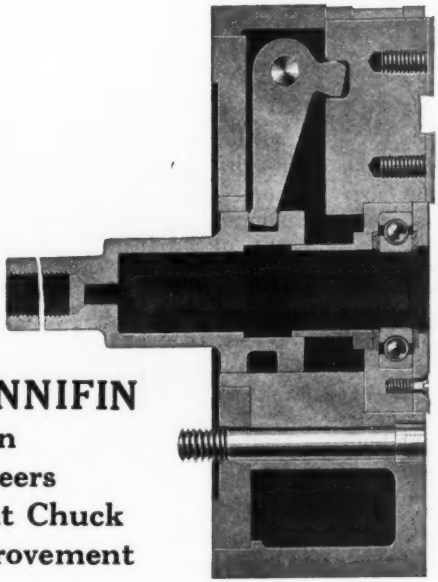
4. Additional accident cost due to higher rate of accident among new employees.

It should be noted here that too much stress should not be placed on the face value of figures of labor turnover and its costs. Conclusions should be drawn always with caution, until methods of compiling them and the reasons for compiling them are known. As a general index and barometer of the trend and current of the labor organization, labor turnover figures, if carefully prepared, are useful.

A situation is sometimes met, however, in which the figures, if viewed superficially, fail to reveal the fact that there exists a rapid turnover among 15 or 20 per cent of the force, while the other workers remain fairly constant. What is needed is a measure of labor stability. According to the United States Coal Commission, labor stability is defined as "the stable force is that group of individuals who were not separated from

You Can Eliminate Pilot Bushing Troubles With Hannifin Chucks

(AIR-OPERATED)



BALL BEARING PILOT BUSHINGS

HANNIFIN Again Pioneers Great Chuck Improvement

Available With New Series BB Hannifin Chucks

THE LATEST DEVELOPMENT of Hannifin engineers—an air chuck with a ball bearing pilot bushing—places Hannifin products another full stride ahead of the field, and again illustrates the ability of the Hannifin organization to anticipate and meet the needs of air chuck users.

The principal advantage of a ball bearing pilot bushing is that the hole in the inner ball race serves as a pilot bushing. Eliminates wear, friction and galling; insures free and accurate alignment of the pilot inside the bushing without danger of the seizing that occurs with old-style rigid or non-rotating pilot bushings.

Hannifin Air Chucks with *dust-proof ball bearing pilot bushings* as integral parts of the pilot bushings plates are available now in all sizes.

WRITE FOR CATALOG MS-11

HANNIFIN MFG. CO. 621-631 S. Kolmar Ave. CHICAGO, ILLINOIS

GREAT BRITAIN—Coats Machine Tool Co. 14 Palmer St., London, England.

GERMANY—George Stenzel Co. Frederick Strasse, Berlin, Germany.

FRANCE—Fenwick Freres Co., 8 Rue De Rocroy, Paris, France.

the payroll during the year. An absence of two or more pay periods constitutes a separation."

The ratio or percentage of stable force is computed by dividing the number in this group by the average working force. It permits the employment management to recognize the real magnitude of the labor turnover by noticing the proportion of the force among which it takes place. For example, one company showed a labor turnover percentage of 198 and a stable force percentage of 40. These figures mean that practically twice the average number of employees on all jobs left only a little more than half the jobs in the plant. The labor turnover figures alone do not show the seriousness of this situation.

Account must be taken of the fact that a certain amount of turnover may be a natural measure of self-defence against the monotony of certain kinds of work. A degree of shifting from one plant to another may be a healthy and socially desirable protest against certain methods of utilizing people. It may be impossible to do much to compensate for the sameness and dullness of the work in one plant, and in such a plant, to attribute inefficiency to the employment office because of a high labor turnover, is unfair. This is a use of figures without taking into consideration any other factors.

There is, indeed, the real danger that managers who have installed employment departments will take it as axiomatic that the amount of turnover is a direct index of the employment department's efficiency. It may be or it may not, but until the figures are carefully analyzed and compared with those of previous years and of other plants similarly situated, it is unscientific to draw this conclusion.

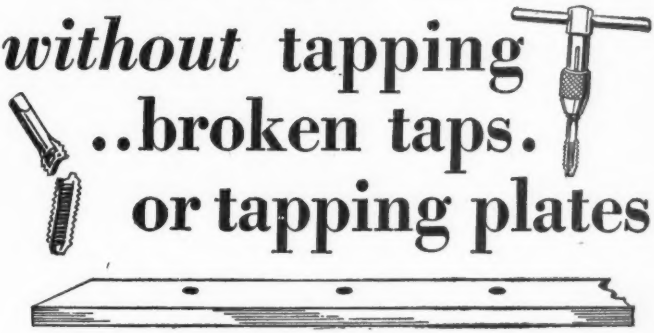
If turnover is a symptom of some maladjustment, the cure should remove the symptom. One outstanding remedy is the introduction of functionalized employment offices in charge of trained executives of a superior type. This invariably results in an immediate and marked reduction in the amount of labor turnover. Investigation has shown that the concentration in one office of all work connected with selection of employees and in subsequent adjustments has almost without exception brought labor turnover within a one-year period from an abnormal and excessive figure to one more reasonable and normal.

Finally, mention should be made of a somewhat more elaborate plan of computing all the labor losses in terms of productive hours. Under this method, labor loss is conceived as a combination of the following measurable factors:

1. Original failure to secure the right or standard number employees.
2. Failure to maintain the number of employees regularly up to standard.
3. Hiring new workers to replace lost ones.
4. Poor attendance (absenteeism and tardiness).

This method is based on the assumption of a standard working force and a standard flow of production. The figures used to indicate labor loss are based on divergence from this standard caused by the factors listed above. The only criticism of this method lies in the fact that the great majority of plants could not use it because they have not as yet determined what, for them, is a standard work force or a standard day's work per unit of man power. The intelligent computation of labor turnover requires not only merely good cost accounting records, but good planning, routing and scheduling procedure.

Fasten thin sheet metal *without* tapping ..broken taps. or tapping plates



Just punch a hole and turn in this Self-tapping Screw

HOLES cannot be successfully tapped in thin sheet metal unless a tapping plate or other auxiliary device is used to provide a sufficiently heavy cross section to tap into.

With Parker-Kalon Hardened Self-tapping Sheet Metal Screws secure fastenings can be made to the thinnest of sheet metal . . . easily and quickly. No slow, costly tapping necessary . . . no broken taps . . . no tapping plates. The time, labor and cost of making assemblies is reduced considerably.

Self-tapping Screws cut their own thread in the sheet metal. Just turn them into a pierced or drilled hole with a screw driver. Hundreds of applications prove that fastenings made this easy way stand up under vibration and severe service conditions.

Tell us what your fastening job is and we will send samples free, for you to test.

Parker-Kalon Corporation,
192-196 Varick St., New York.

Please send me a handful of Hardened Self-tapping Screws. I want to try them out for

.....

Name.....

Address.....

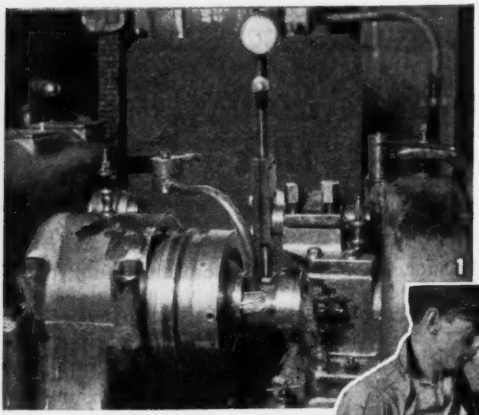
PARKER-KALON
HARDENED SELF-TAPPING
Sheet Metal Screws

PATENTED
APR 3, 1919—No 1299232 — MAR 28, 1922—No 1411184
AUG 14, 1923—No 1465148 — FEB 10, 1925—No 1526188
OTHERS PENDING

Machining Parts for Tuthill Pumps

By DONALD A. CLARK

IN THE development of mechanical means for the handling of materials, liquids, as well as solids, have been taken into consideration. Hydraulic machinery, oil burners, the loading and unloading of vats and tanks, the lubrication of machines of various types—all these involve the use of pumping units. The construction of such pumps, as they are built in the plant of the Tuthill Pump Company, Chicago, Ill., involves a number of interesting operations which are described here.



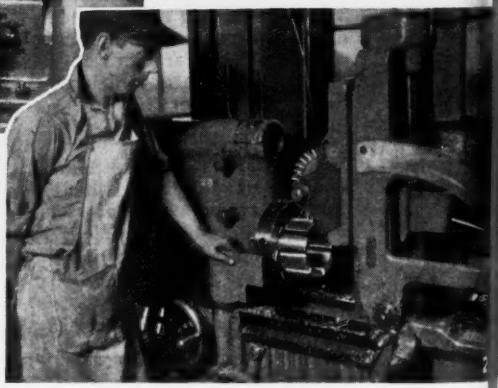
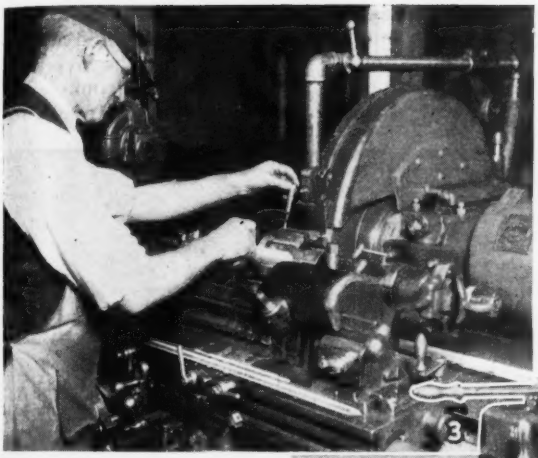


Fig. 1—Milling cup in rotor of unloading pump. Fig. 2—The rotor is slotted on a B. & S. hobbing machine.

The principal operating parts of the Tuthill pump are the idler, the crescent, the rotor, and the shoes. In operation, the idler revolves, meshing with the rotor in much the same way that a pinion meshes with an internal gear and drawing the liquid from one side of the pump to the other, the liquid being confined to its course by the crescent and the two "shoes."

The rotor is first turned, then the "cup" is machined out and the slots are cut. The cups in the larger rotors are formed by milling the stock out with the internal milling machine shown in Fig. 1. The cup in the piece shown is finished to $\frac{1}{16}$ inch deep, within .0005 inch. The carriage carries a Federal indicator which is adjusted so that, as the cutter nears the correct depth, the hand on the dial is operated by an attachment on the lower end of the shaft which rides against the face of the rotor, thus showing the exact depth of the cutter.

The next operation on the rotor is that of slotting, which is performed



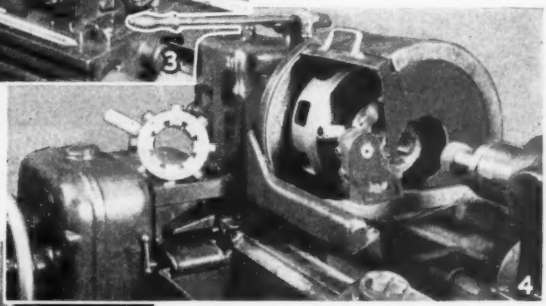
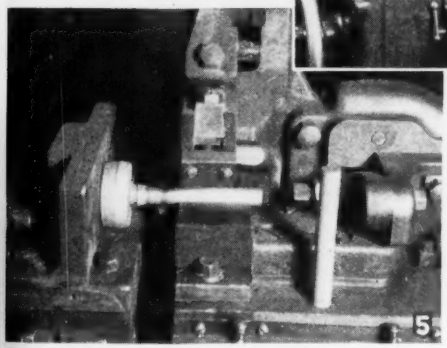


Fig. 3—Grinding the rotor to size. Fig. 4—This machine rough grinds the work, dresses the wheel, and finishes the operation, all automatically. Fig. 5—The rotor and shaft after welding.



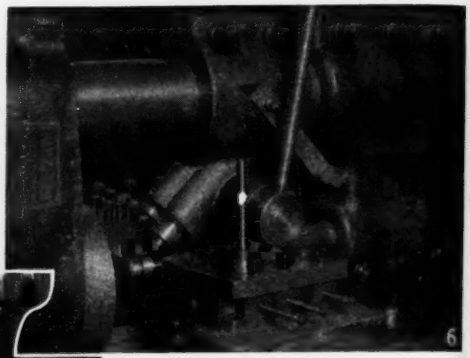
on a Browne & Sharpe gear cutter, as shown in Fig. 2. The rotor shown is 6¾ inches outside diameter with a cup of 5¼ inches diameter. In this operation nine slots are milled, each 3¼ inches deep, leaving nine teeth equally spaced.

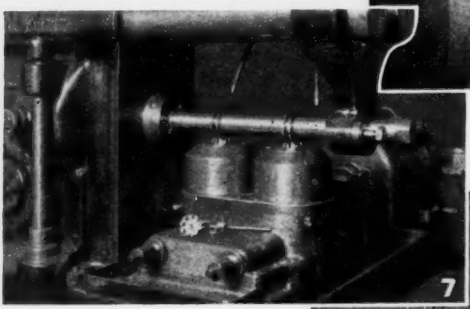
After the slots have been milled, the rotor is ground to size in a Norton grinder, shown in Fig. 3. Both the shaft and the rotor are finished in this operation, the larger diameter being held to 6.750, with a plus allowance of .002 inch. This rotor is used in the construction of the unloading pump, which handles 200 gallons of liquids per minute.

The "shoes" are two steel pieces which ride against the periphery of the rotor as it revolves, and these pieces, therefore, must be finished to the radius of the rotor. The radius in the shoe is finished by a grinding operation, eight pieces being finished in one operation by the use of a Teromatic grinding machine and a fixture, or "shuttle," in which the pieces are held, shown in Fig. 4. Two shuttles are provided so that the operator can be reloading one while the other is in operation on the machine. Provision is made so that the shuttle can be instantly located and clamped in position, and as the machine automatically grinds the piece to the correct size, the operator is kept busy unloading and reloading the shuttles. Once started, the machine roughs the pieces to within .002 inch of size, then it proceeds to

automatically dress the wheel and finish the work to size. No time is lost in gauging the work and the machine performs all the functions mentioned, automatically and accurately, regardless of the amount of stock to be removed or the size of the wheel.

The rotor for the smaller type of pump is made of two pieces, the shaft being cut from bar stock and welded to the rotor. The welding is done electrically, using the Thomson electric welder. A view of the piece just after the welding operation has been completed is shown in Fig. 5. The head, which is a forging, is placed in position and the shaft, clamped between two jaws, is joined to it. The two pieces come to a welding heat at the point of contact quickly, and the metal is easily fused by means of a long lever.





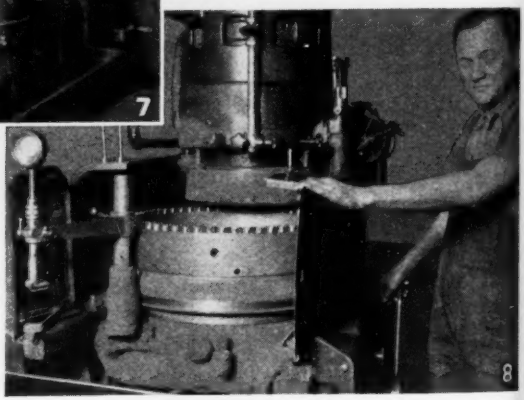


Fig. 6—Machining rotors in the Stub lathe. Fig. 7—The "Milwaukee" mills the slots. Fig. 8—Surface-grinding the rotors.

After welding, the rotor is turned, faced, and grooved in a Sundstrand "Stub" lathe, Fig. 6. Eight tools are used on this operation, three in the front tool block, four in the rear block, and one overhead. The three in the front block turn the head and the shaft, while the tools in the rear face both front and back of the head, and face and chamfer the end of the shaft. A necking operation is performed with the overhead tool, which is done by hand. This piece is finished complete, ready for slotting, in three minutes.

The next operation on the small rotor is that of milling the slots, which is done with the aid of a Milwaukee miller, Fig. 7, and an automatic fixture. Four saws are used, each gang of two saws milling four slots in the piece in one operation.

TWIN DISC
CLUTCHES

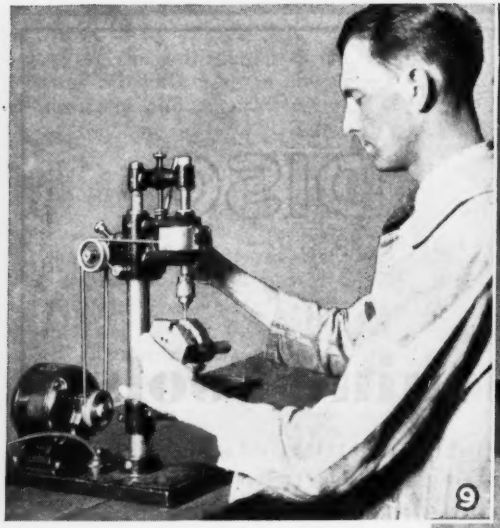
For Machine Tools

THIS COMPANY manufactures two distinct types of plate clutches designed to improve and simplify the drive control of machine tools.

One of these types is a dry plate clutch with either single or double driving plates. The other is a multiple plate clutch designed to operate in a bath of oil. Each type is made in all practical sizes, covering most of the requirements of machine tool design and operation.

We can already refer you to an impressive list of prominent machine tool manufacturers who have adopted Twin Disc clutches as standard for the drive control of their machines. A post card or letter will bring you valuable information promptly. Write.

TWIN DISC CLUTCH COMPANY
RACINE WISCONSIN



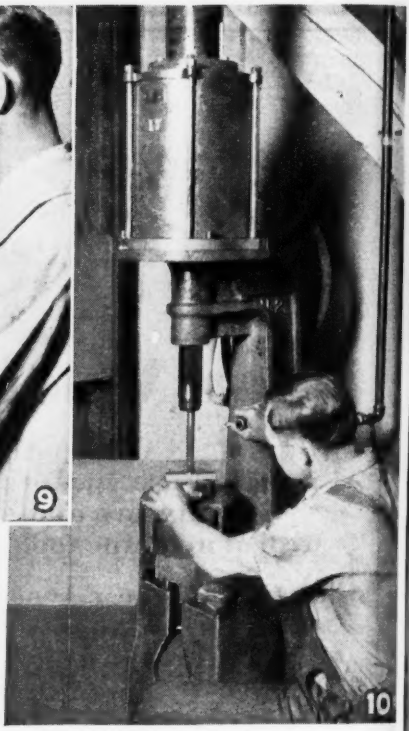


Fig. 9—All small holes are drilled in the "A. M." sensitive drill. Fig. 10—Keyways are quickly cut by the push-broaching method, using this Hannifin air-operated press.

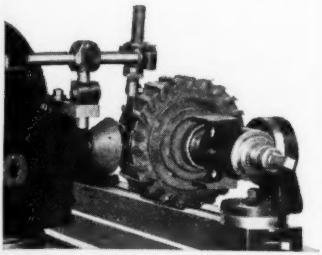
As the work clears the saws, the table reverses to starting position, the chucks index, and the work again feeds past the saws, all of which takes place automatically. With the exception of the time required to stop the machine, change pieces, and start the machine again, the operator is free to attend to other work. The slots are milled within .001 inch of drawing size and the dimension between the slots is held to the same limit.

The rotors are now heat-treated, then the faces of the cup-ends are ground in the surface grinding machine shown in Fig. 8. A rotary fixture is used, holding fifty-eight pieces, and a continuous check is kept on the amount of stock on the work by means of a Federal dial gage, which is held so that the lower end of the plunger rests on the work as the table rotates. This method of continuous gauging practically eliminates spoilage and saves time that would otherwise be spent in gauging the work by hand. The dimension from the top to the bottom of the cup is held to .0005 inch and the fifty-eight pieces are finished in twenty minutes.

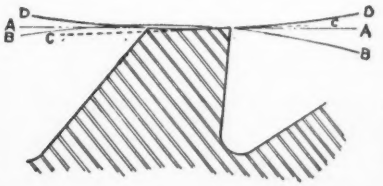
The mechanic shown in Fig. 9 is drilling a $\frac{1}{16}$-inch hole to serve as a suction vent in a pump housing, and is performing this operation with the aid of an "A. M." sensitive drilling machine. A jig is used to hold the work. The extreme sensitiveness of the machine at high speeds makes it particularly adaptable for the fine drilling work involved in the construction of the oil-burner pumps. The fact that the machine is self-contained and is comparatively light

(Continued on page 40)

Cutting tools last longer—cut better—when properly ground

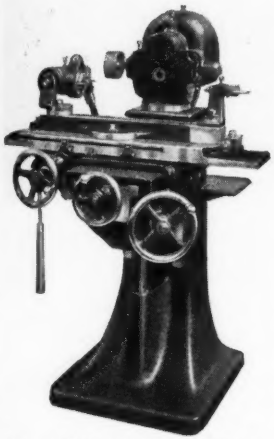


Sharpening the Periphery of an Inserted Tooth Face Mill.



DD represents periphery of grinding wheel, BB circumference of cutter, AA desired clearance as obtained with cup wheel on Ohio Grinder, CC clearance angle obtained using periphery of grinding wheel for clearance.

OESTERLEIN-OHIO Grinders Preserve Cutter Life by Correct Grinding



No. 2 Ohio Universal and Tool Grinder, Motor Driven, Forced Feed Table Lubrication.

MANY cutters pass their stage of usefulness prematurely due to incorrect grinding, but proper grinding costs no more than any other.

Ohio Grinders produce a solid backed cutting edge that has double the life of any hollow one.

The added life given to cutters is actually a saving in cutter investment. These small savings mount rapidly and soon pay for your machine.

It's just as easy to make your tools do more work for less cost, even though the initial investment may be a trifle more.

The sketch above shows the difference between right and wrong grinding of face mills. The illustration at the left, correct set-up on an Ohio Grinder.

You can get a complete story on tool grinding from our booklet "E." Write for your copy today.

THE OESTERLEIN MACHINE CO., Cincinnati, Ohio

OESTERLEIN (OHIO)
MILLING GRINDING DRILLING
EQUIPMENT

Manufacturing Tuthill Pumps

(Continued from page 36)

makes it possible to move it about on the assembly bench and saves handling of the work.

The operation of broaching a $\frac{3}{16}$-inch keyway in the rotor of a gasoline dispensing pump, for which operation a Hannifin air-operated arbor press is used, is shown in process in Fig. 10. The operation is performed quickly and accurately; the speed of the ram being easily controlled by the lever shown in the operator's right hand. This press is also used to broach keyways in pulleys and couplings, to press bushings in and out of the various parts, and so on.

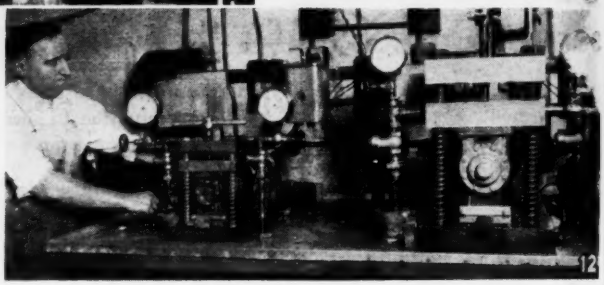


Fig. 11—Pumps for oil-burners being given the "running-in" test. Fig. 12—Each pump is given a test for pressure, capacity, and leaks.

The illustration Fig. 11 shows one of the running-in stands where the pumps are given their first work-out after being assembled. The eighteen pumps on this stand are of the type that is made for use with oil-burning apparatus. Any pump that shows signs of leakage is rejected, and each one must be able to deliver a flow at a pre-determined pressure. Fig. 14 shows the apparatus used for testing the larger sizes of pumps. Each outfit is equipped with pressure and vacuum gages, and the pump is tested for pressure, capacity, and leaks.

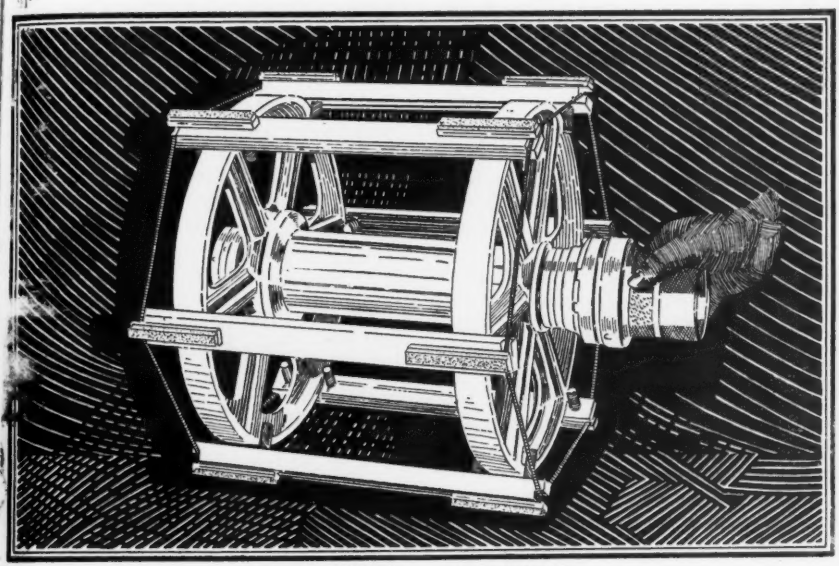
Specializing on Die Work

(Continued from page 20)

furnaces and the tempering baths, eliminating any element of chance in so far as these operations are concerned. Each part that comes to this department is accompanied by a ticket which bears both the name of the customer and the name of the die maker, and which specifies the temperature to which the piece must be heated for hardening, the temperature of the quenching medium, the drawing temperature, drawing time, and with a space for the result of the Rockwell test. These tickets are later filed as a matter of record.

The Rockwell tester, in use for testing the hardness of a die to be used for making parts for hall clocks, is shown in Fig. 12. Samples of some of the parts for which dies have been made by this company are illustrated in Fig. 13.

How big is *your* job of cylinder grinding?



HUTTO MODEL "C" GRINDER

There are Hutto Cylinder Grinders and Machines for all jobs up to 60 inches in diameter

DIAMETERS, lengths of bores, tolerances or time limits are not obstacles. If you have an internal grinding operation on work as small as ¾ths of an inch in diameter or as large as 60 inches in diameter, we can take care of your requirements.

Years of experience building precision grinders for production and service work enable us to assure you greater speed, accuracy and economical operation on internal grinding.

The Model "C" Grinder (illustrated) is designed for cylinders 7 to 30 inches in diameter. Ideal for large bores, such as Diesel engines, air compressors, stationary engines, pump sleeves, valve bodies, locomotive cylinders and similar work.

Our engineers will be very glad to confer with you. Their services are available at your convenience and a request for them to call will not obligate you. Correspondence is solicited.

HUTTO ENGINEERING COMPANY, INC.

542 LYCASTE AVENUE DETROIT, MICHIGAN

Encouraging Good Work

By RUSSELL J. WALDO

ONE of the best plans for encouraging the workers to be at work on time, to encourage careful work, and to avoid accidents, has been found in an Ohio concern employing over 1,600 men. The plan also provides an inducement to study for improvement.

In order to put the plan into effect, the workmen are classified as follows:

Class A—Married men, with children, owning or purchasing their own homes, attending church at regular intervals, showing no evidence of liquor-drinking, and pursuing some regular course of study that has a bearing on their work.

Class B—Single men, living at home or in good, respectable quarters, attending church at regular intervals, and pursuing some form of study intended to make them more proficient in their work.

Class C—All others, including those who are apparently making no effort to own their own home, those who do not attend church or who have questionable habits, or who are making no effort to advance themselves in their work.

A complete list of the men is posted in a central location in the plant, the list being enclosed in a glass case to keep it clean and prevent defacement. On a certain day of each month one of the employment department clerks posts small paper stars after the names of the men who are entitled to them, in accordance with a list of credits which is also posted on the board. The list of credits is as follows:

Class A suggestion, one star.
Class B suggestion, one star.
Class C suggestion, one star.
Three months' study, one star.
On time every day for six months, one star.
Ninety-five per cent of work passed by inspector, three months period, one star.

Class A includes suggestions for the protection of the workers against possible death or injury; Class B includes suggestions for the improvement of the product, and Class C includes suggestions for improvements in methods.

Five stars in a year entitles a workman on hourly rate to an increase of five cents per hour, or an increase of $1.25 per week to those on weekly salary, or $5.00 per month increase to a man on a monthly salary. The winning of ten stars entitles the recipient to double the amount indicated—10 cents per hour, $2.50 per week, or $10.00 per month. Raises are granted in multiples of five at the end of the year, and the extra stars are carried over to be applied on the next year's credits.

Any employee who fails to receive five stars during the course of the year is not considered a desirable employee, and failure to receive five stars in two years is considered sufficient cause for dismissal. Acceptable reasons for being late are allowed, and the rejection of work due to defective castings or to faulty tools is not recorded against the workman. The year ends on December 15th, and the notice of increase is placed in the pay envelope at Christmas time. The hourly workers find the increased amount in the envelope, the weekly workers obtain their increase in the last pay before Christmas, and those on monthly salaries are given the

(Continued on page 56)

A Splendid Investment For Every Machine Shop

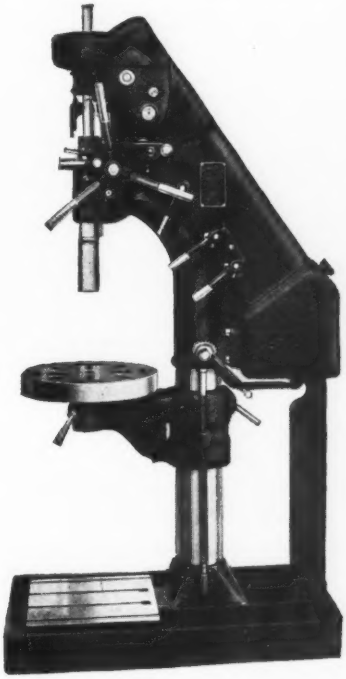
FOR driving drills and taps, up to 1¼-inch diameter, to their full capacity in any metal, the 20-inch Self-Oiling, All-Geared Drill is unexcelled. Some of its many features and advantages are listed below. Based upon sound engineering, built of the best materials, with the finest workmanship; its price is surprisingly low when its high quality and profitable productive capacity are considered. Installation cost is low, also—it has no inherent belts and is delivered complete, ready to run.

FEATURES OF THE 20-INCH SELF-OILING ALL-GEARED DRILL

Especially heavy construction
Right angle drive
Very rigid and powerful
Instant change of feeds and speeds
Chrome nickel steel transmission
Eight geared speeds
Self-oiling bearings
Eight geared feeds
Coil spring spindle-return
No cone or inherent belts
Operates easily
Multiple disc clutch

Complete description is in our catalog—send for it today.

Write for Catalog "U"



20-inch Self-Oiling, All-Geared Drill.

BARNES DRILL COMPANY

801-851 CHESTNUT STREET ROCKFORD, ILLINOIS

The Nature and Properties of Iron and Steel. VI.

By GEORGE M. ENOS
Assistant Professor of Metallurgy, University of Cincinnati

A DIAGRAM to be of use in heat treating steel must be plotted so as to indicate the changes in the form of the iron, and the change in magnetic qualities, as well as the solubility of the carbon in iron. Accordingly, that portion of the iron carbon diagram involving location of the lines named Ac3, Ac2 and so on are critical points on heating for the various carbon percentages. The shaded area marked "critical range" indicates the temperatures above which it is necessary to heat steel for a full anneal, a normalizing, or a hardening operation. Ac ranges are usually preferred for location of heat treating temperatures.

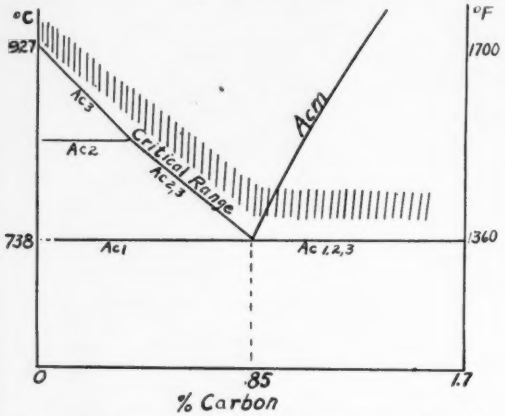


Fig. 1—Section of Iron-Carbon Diagram, Showing Location of Thermal Critical Points.

thermal critical points may be plotted to a larger scale as shown in Fig. 1.

Grain Size Changes in Steel

Any of the changes on cooling of steel discussed in preceding articles will be reversed on heating. The location of the thermal critical points on heating will be higher on heating than on cooling. Thermal critical points in steel obtained on heating are called Ac points; those obtained on cooling are called Ar points. The

On heating a steel through the critical range, the grain size will change. If the steel is initially coarse-grained, it will be refined, and if initially fine-grained, a new structure will appear, but similar to the original. If the heating be continued and temperature raised well above the critical range, grain growth will occur; in fact, the steel may be so badly overheated that it will become brittle and worthless due to the excessively large grains. Cooling through the critical ranges does not decrease grain size. Refinement of grain size can only be secured by heating from below the critical range through the critical range, care being taken that the temperature reached is not excessively far above the desired point for the particular carbon content involved.

While it is true that grain size is not refined except by heating through the critical range, yet strains may be released, and recrystallization may be said to occur at temperature below

For Better Ground Tools and Cutters

This Completely Motorized Machine

—is the ideal Tool Room Grinding machine. Not only will it handle practically all demands for tool and cutter sharpening, but it is also suitable for light cylindrical, internal and surface grinding operations.

With no overhead works, pulleys and belts, it may be placed in any tool crib and operated at any time independent of line shaft power. The universal features, convenience of operation, excellence of design and workmanship, and general appearance are unsurpassed.

Let us send you complete specifications and prices.

NORTON COMPANY
Worcester, Mass.

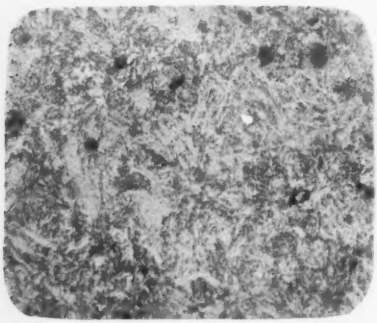
New York Detroit
Chicago Philadelphia
Cleveland Hartford
Syracuse

M-212

NORTON
GRINDING MACHINES

700 degrees C. in the case of worked steel.

Before proceeding with a discussion of the various heat-treating operations, the micro-constituents of steel should be defined. These constituents may be recognized under the microscope on polished and etched samples.



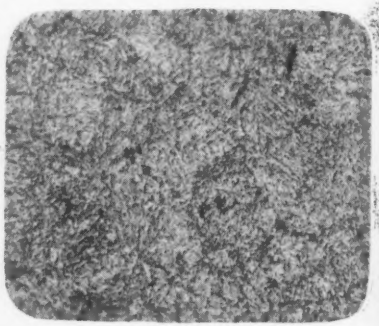


Fig. 2—Photomicrograph Showing Martensite (X200). Fig. 3—Photomicrograph Showing Martensite (Light Needles), Sorbite (Gray), and Troostite (Nodules) (X200).

Ferrite—pure iron. It may be alpha, beta or gamma variety, depending on temperature. It is relatively soft, ductile, and malleable.

Cementite—iron carbide (Fe_3C). Very hard and brittle.

Pearlite—an intimate mechanical mixture of ferrite and cementite, in such proportions that about .85 per cent carbon is present in the constituent. Strong and relatively hard.

Austenite—the solid solution of carbon (or carbon carbide) in gamma iron. It is only stable at high temperatures, in plain carbon steels.

Martensite—a hard, fairly strong material, the first product formed on the decomposition of austenite. It is fine-grained, usually having a needle-like structure. It is the chief constituent of hardened steels that are not tempered.

Troostite—a product of the breakdown of austenite and of martensite. It is fairly hard and tough and strong. Recognized as nodules, usually in a matrix of martensite. It also occurs in other forms. It is the chief constituent in tempered steels

Sorbite—a product of the breakdown of austenite by way of Martensite and Troostite. Sorbite is more massive than Pearlite, into which it will transform if tempered at a high enough temperature. It is characteristic of toughened steels, those which after hardening have been reheated below, but near the critical range.

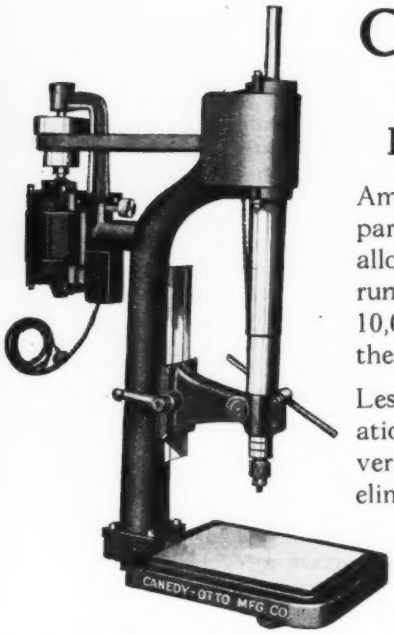
Typical views of some of these micro-constituents are shown in Figs. 2, 3 and 4. The relative hardness of the micro-constituents of steel are given by Boynton as follows:

Ferrite	1
Pearlite	43
Sorbite	52
Troostite	88
Austenite	104
Martensite	239
Cementite	272

Heat Treating Operations

In Fig. 5 a general conception of heat treating is shown graphically. Any simple heat treatment involves the heating of an article to some definite temperature range, the holding of the article at that temperature for

HIGH SPEED WITH SAFETY



C-O 14-Inch High Speed
Sliding Head Sensitive Drill.

C-O DRILLS

OPERATE AT HIGHER SPEEDS!

Ample protection of all moving parts, plus a well-balanced design, allow this Canedy-Otto Drill to be run at very high speeds—up to 10,000 R.P.M.—without injury to the machine.

Less power is required for the operation of C-O Drills because the vertical mounting of the motor eliminates idlers, pulleys, intermediate cone pulleys and all twists and turns in belts which reduce the friction considerably.

The drill is furnished complete ready for operation by attaching to a lamp socket.

CANEDY-OTTO MANUFACTURING CO.

General Offices and Factory: CHICAGO HEIGHTS, ILL.

New York Branch:
407 Broome St.
New York City

Complete Stock At All Branches

San Francisco Branch:
955 Folsom St.
San Francisco, Cal.

a length of time sufficient to permit the piece to become saturated with heat, and the cooling to room temperature. In general, the rate of heating should be slow and uniform as indicated by the line **AB**. The length of the line **BC** indicates the time of holding at the desired temperature, and depends upon the mass and area

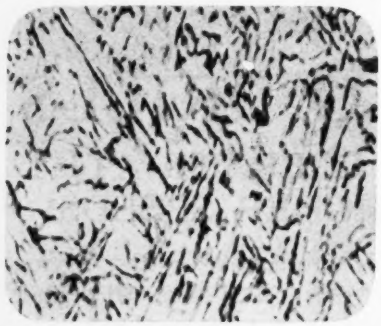


Fig. 4—Photomicrograph Showing the Martensite-Troostite Transformation (X1000). (R. O. MacDuffie.)

of the piece. The slope of the line **CD** will vary with the actual heat treatment. It is steep for a hardening operation and gentle for annealing. Successive heat treatments may be given for the purpose of securing properties in the metal not obtainable in a single operation.

The variables affecting heat treating operations are: Composition, kind and amount of work and heat treatment performed, the size and shape of the article, the rate of heating and the rate of cooling.

Annealing

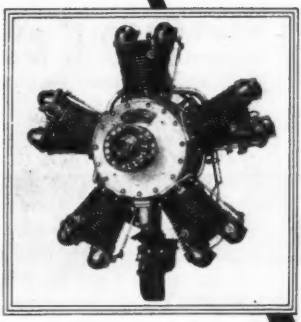
Annealing operations are always characterized by relatively slow cooling from the temperature chosen for the anneal. In Fig. 6 the annealing operations are shown graphically.

Full Annealing. The alloy, steel, (or cast iron), should be heated slowly and carefully above the critical range, and cooled very slowly. The rate of cooling is retarded by allowing the work to cool with the furnace, or by packing in lime, sand, or other insulating material. The temperature to which the steel should be heated can be determined by reference to the diagram Fig. 1, once the carbon content is known, assuming that no alloying elements are present. The critical range temperature should be exceeded, but not by such an amount that grain growth will occur. In a section of any appreciable size there will be a temperature gradient between the outside and inside of the piece. Therefore the temperature of the furnace should not exceed the highest temperature desired in the piece at any point. Time should be allowed for temperature equalization within the piece. If this is not done or if the temperature of the furnace is raised above the proper range, the work may be damaged. If an effort is made to force heat into the interior of the article by raising the temperature excessively high, grain growth will occur in the outer zones, with a possibility of weakening and embrittling the steel.

If the steel cools slowly there should be few strains set up, and hence little danger exists of the piece warping. If surface appearance is important, a reducing atmosphere should be maintained in the furnace to prevent scaling.

Normalizing. As far as heating is concerned, the normalizing operation is the same as heating for a full anneal, except that the temperature reached may be somewhat higher. In normalizing the rate of cooling is increased by allowing the piece to cool in still air at ordinary temperature.

On the very slow cooling of hypereutectoid steels, free cementite will be formed at the grain boundaries. This form of cementite is objection-

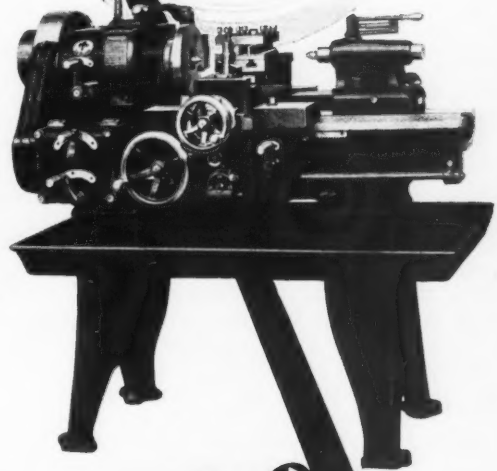


Records Broken

LeBlond lathes and LeBlond aircraft engines have established records in their respective fields. Both built for speed, under the highest standards of accuracy and precision.

The lathe illustrated is our 11" Rapid Production, a time saver on work to be turned and faced simultaneously.

THE
R. K. LeBLOND MCH. TOOL CO.
Cincinnati, Ohio



speed

able if the steel is to be machined. It may be desirable to heat the steel to a temperature above the Acm line (Fig. 1) in order to dissolve the network of cementite. Cooling in air form above Acm will prevent the formation of the hard cementite network. Normalizing treatments are often given to forging steels which are later to be hardened.

Shop-Annealing. As will be noted

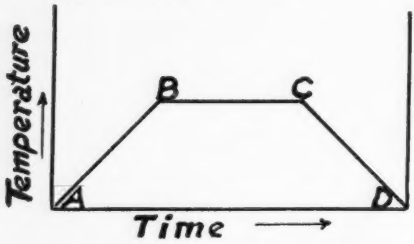


Fig. 5—Graph Showing Relationship Between Time and Temperature in Heat Treating.

in Fig. 6, the operation of shop annealing does not require that the piece be heated above the critical range. The object of the shop anneal is to release strain in cold worked steel (usually sheets or wire), thus permitting further cold work.

Spheroidizing. The object of this treatment is to change the iron carbide to a globular condition. Cementite is extremely hard and brittle, and if it occurs as plates or spines it increases machining difficulties. The cementite (iron carbide) occurs free in hyper-eutectoid steels, and in order to bring it to a globular condition, so that the steel will not only be stronger, but will machine more easily, the steel may be treated either by (a) alternately heating within and slightly below the critical range or (b) by heating just below the critical range for a considerable time period. The first treatment is suitable for small objects of high carbon steel. The second treatment is generally applicable. Either treatment will also spheroidize the cementite which forms a part of the pearlite, either in hypo-eutectoid or hyper-eutectoid steels.

Patenting. In the manufacture of steel wire, in order to improve the ductility after cold work, the steel may be heated above the critical range and cooled in molten lead held at about 700 degrees F., or by cooling in air. This treatment is really a normalizing operation. In any normalizing operation the microstructures obtained will usually contain sorbite as a distinguishing characteristic, and possibly free ferrite or free cementite according to the carbon content of the steel.

Other annealing operations include "malleablizing," used in producing malleable iron, as discussed in the first article of this series; "graphitizing," a process of annealing cast iron (or high carbon-high silicon steels) whereby combined carbon is changed to free carbon. The graphitizing treatment is never intentionally applied to steel. "Tempering" (or "drawing") is also an annealing operation, but discussion of this important operation will be deferred until hardening is discussed, since a true tempering operation is only carried out on hardened steels.

Hardening

The steel to be hardened should be heated slowly and uniformly within or above the critical range, held at that temperature for a sufficient time to permit saturation of the work with heat, as explained in the discussion of full annealing, and then quenched. Quenching produces rapid cooling. The quenching bath may be brine, water, oil, or some other suitable medium. Plain carbon steel will not

(Continued on page 54)

INDUSTRY OF THE NEW CARBORUNDUM BRAND FINISHING COMPOUNDS

REG. U.S. PAT. OFF.

DEVELOPED through scientific research these new compounds have made possible a distinct advancement in the art of finishing or lapping.

To meet all conditions either of two types of abrasives are used in their making—Carborundum (silicon carbide)—Aloxite (crystalline alumina).

Positive accuracy in the grading of the abrasive grains—scientific methods of compounding—the production of correct grades of compounds to meet definite conditions—all indicate how thorough has been the development of these compounds.

THE FEATURES OF CARBORUNDUM BRAND FINISHING COMPOUNDS

Free cutting, clean cutting, fast cutting, cool cutting.
Uniformity of grain size—insuring uniform finish without deep grain marks.
New type of carrier medium—neither an oil, grease or water mixture, but combining the virtues of all three.
Unaffected by temperature changes.
Abrasive grain held in absolute and unchangeable suspension and uniformly separated in all directions under all conditions.
Non-flowing—non-dripping, non-corrosive.
Will not harm operator's skin.
Does not require use of explosive cleaner.

Carborundum Brand Finishing Compounds are made in twenty-two grades to meet all finishing or lapping conditions.

NIAGARA FALLS, N. Y.

PHILADELPHIA, CINCINNATI, LTD., NIAGARA FALLS, ONT.

The Carborundum Company
Niagara Falls, N. Y.

Please send me free sample can of Carborundum Brand Finishing Compound. (State purpose for which Compound is to be used.)

Name _____

Street _____

City _____ State _____

My Jobber is _____

Properties of Iron and Steel

(Continued from page 50)

harden usefully unless at least 0.4 per cent carbon is present. The higher the carbon content, the lower the critical range will be, between low carbona and eutctoid point. Above 0.85 per cent carbon the critical range

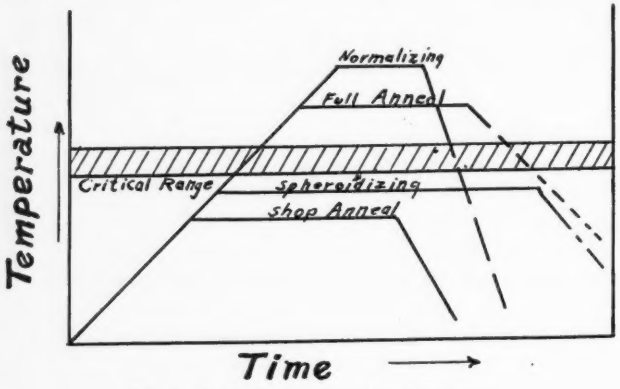


Fig. 6—Diagram of Annealing Operations.

(see Fig. 1), will be the same for any carbon content of the steel. Hardening usually accomplishes refinement of the grain size, just as a full anneal does, but the transition of the austenite is retarded by the quick removal of heat. Hence only the first break-down products of austenite will be formed on a drastic quench. These are martensite and troostite. These products are unstable; that is, they have the tendency to decompose into pearlite and either ferrite or cementite, depending upon the carbon content. At room temperature this tendency is not marked.

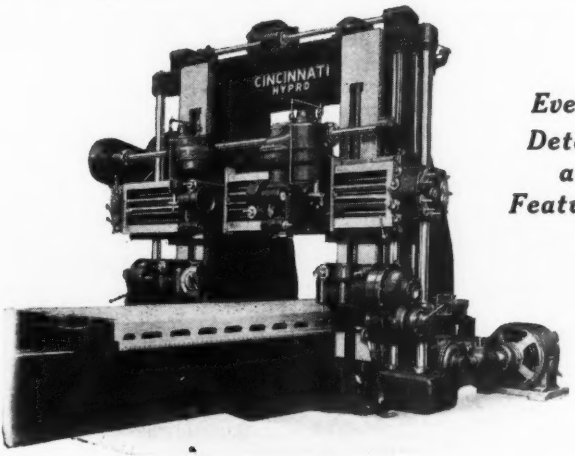
The quick removal of the heat tends to set up strains within the steel, particularly if the section is irregular in shape, or if the interior and surface temperatures differ. Even if the temperature were the same throughout, the quenching would act first on the surface, and the interior would necessarily cool at a different rate. Thus in any hardening operation strains will be set up, warping, distortion, or actual cracks may occur unless the steel section has been properly designed (no sharp corners, etc.) properly heated, and properly quenched. In Fig. 7, the hardening operation is illustrated graphically. (The graphical treatments of "Heat Treating Operations" are patterned after figures devised and published by Professor Sauveur and Professor Boylston.)

Tempering and Toughening

The tempering operation is always carried on at a temperature well below the critical range, as illustrated in Fig. 7. It consists of heating the steel to some predetermined temperature which will release strains and permit the transition of the harder micro-constituents formed on quenching to softer ones; for example, from a martensite-troostite structure to a troostite-sorbite structure. If the tempering temperature is high, more of the sorbite will be formed, and the steel will be tougher but not so hard. In general, lower tempering temperatures release strain and produce some softening. Higher tempering temperatures release strain, decrease hardness materially, and so "toughen" the steel.

Tempering temperatures are sometimes chosen by the "temper color" method; that is, after hardening, the polished steel on reheating will show

NEW CINCINNATI HYPRO PLANER MILLER



Every Detail a Feature!

Frictionless and vibrationless drive through Silent Chains

Both the vertical feeds and the two transverse milling heads of this new Cincinnati Hypro Planer Type Miller are efficiently operated through Silent Chain drives.

This patented silent chain insures a smooth flow of power to the cutting tools at all speeds.

Ask Hypro Engineers to detail this and the many other features of the Hypro Planer Type Miller.

Other features of the Hypro Planer Type Miller:

Complete Electrical Control.
Independent Rapid Traverse to All Heads.
Independent Power Feed to All Heads, Rail and Table.
75 Feed and Spindle Speeds.

THE CINCINNATI PLANER CO.

3100 SOUTH STREET CINCINNATI, OHIO

the temper colors at the temperature indicated in the accompanying table.

Table of Temper Colors

Temperature Centigrade	Temperature Fahrenheit	Name of Oxide Color
260	500	Brown Yellow
232	450	Medium Yellow
343	650	Gray Green
316	600	Peacock Blue
288	550	Dark Purple
Atmospheric		Normal steel.

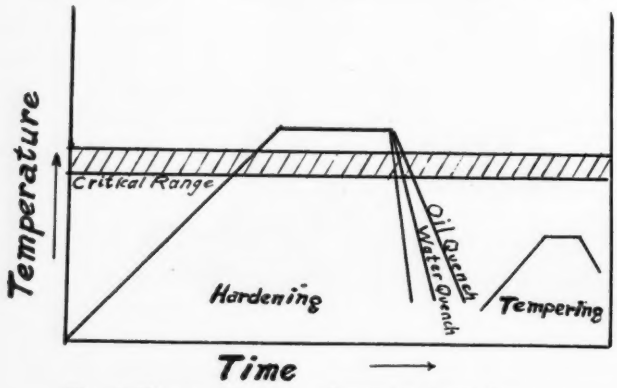


Fig. 7—Diagram Illustrating Tempering Operations.

This method is particularly suitable where no pyrometric equipment is available, and is often used in tempering small tools, such as chisels. Experienced operators will reheat until the desired color is obtained, and then quench so that the equivalent temperature is not exceeded. In making small tools, the point and shank may be heated to the hardening temperature, the tip quenched, polished, and then the heat stored in the shank allowed to flow to the hardened end until the proper color is reached, when the entire piece is quenched. If a piece of work requires hardening throughout, to be followed by tempering, this method is not always convenient or accurate. A furnace may be used which is not allowed to exceed the desired temperature. Once the piece reaches that temperature the rate of cooling is immaterial in a tempering or toughening operation.

Special Methods

In annealing, hardening and tempering, special devices may be employed to locate the proper temperature which the furnace should reach; for example, the location of the critical points.

The Leeds-Northup Company furnishes an electric furnace with pyrometric control and a recorder, so that the absorption of heat as the steel passes through the critical range is noted on an automatically recorded time-temperature graph. The Dilatometer, used with Rockwell electric furnaces, also furnishes a record. In this device, the volumetric change is automatically plotted as the steel passes through the critical range. With either of these devices it is not necessary to know the composition of the steel before the start of the operation.

Encouraging Good Work

(Continued from page 42)

extra amount for the month of December, the day before Christmas.

The superintendent, who is responsible for this information, states that the system outlined has developed a spirit of co-operation and enthusiasm throughout the entire organization. The employees never ask for raises any more, because each and every one knows whether or not he can expect a raise, and when.

"Best for Cutting High-Chromium and High-Carbon Steel"

Says another thoroughly contented and satisfied user of Atkins SILVER STEEL Saws. He says this himself:

"We have found Atkins SILVER STEEL Saws by far the best for cutting the high-chromium and high-carbon steels now used in die-making. We tried all kinds of blades and most of them failed before cutting through one bar. The Atkins Saws sometimes run a month before they need changing."

Manager, Modern Tool Company
222 Post Square, Cincinnati, Ohio

Atkins blades cut from SIX to THIRTY TIMES more metal and cut TWICE AS FAST as any ordinary alloy blade manufactured.

CUTS 6 TO 30 TIMES MORE METAL

Investigate, ask us for detailed chart showing what can be done and the exact cost of doing it in your plant. Send now.

CUTS TWICE AS FAST

The Little Doctor

A First Aid For Drill Press Operators

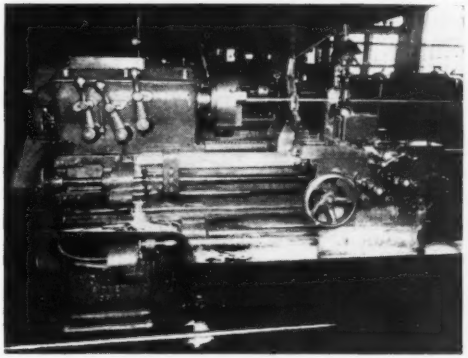
SYMPTOMS	PROBABLE CAUSE	REMEDY
BREAKING of drill.	Spring or back lash in press or work. Too little lip clearance. Too low speed in proportion to the feed. Dull drill.	Test press and work for rigidity and alignment. Regrind properly Increase speed or decrease feed. Sharpen drill.
BREAKING down of outer corners of cutting edges.	Material being drilled has hard spots, scale or sand inclusions. Too much speed. Improper cutting compound. No lubricant at point of drill.	Reduce speed. Use proper cutting compound and correct application.
BREAKING of drill when drilling brass or wood.	Chips clog up flutes.	Increase speed. Use drills designed for these materials.
BROKEN TANG.	Imperfect fit of taper shank in the socket—due to nicks, dirt, burrs or worn out socket.	Get a new socket or ream old one to prevent recurrence.
CHIPPING of margin.	Oversize jig bushing.	Use proper size bushing.
CHIPPING of lip or cutting edges.	Too much feed. Too much lip clearance.	Reduce feed— Regrind properly
CHIPPING or checking of a high speed drill.	Heated and cooled too quickly while grinding or while drilling. Too much feed.	Warm slowly before using. Do not throw cold water on hot drill while grinding or drilling. Reduce feed.
CHANGE in character of chips while drilling.	Change in condition of the drill such as chipping of cutting edge, dulling, etc.	Regrind drill properly.
HOLE too large.	Unequal angle or length of the cutting edges—or both. Loose spindle.	Regrind properly. Test spindle for rigidity.
ONLY one lip cutting.	Unequal length or angle of cutting lips or both.	Regrind drill properly.
SPLITTING up center.	Too little lip clearance. Too much feed.	Regrind with proper lip clearance. Reduce feed.
ROUGH HOLE.	Dull or improperly ground drill. Lack of lubricant or wrong lubricant. Improper set-up. Too much feed	Regrind properly. Lubricate or change lubricant. Reduce feed.

From "Handbook for Drillers," Published by Cleveland Twist Drill Co.

and Use Less of It"

MACHINE TOOL CO.

SIDNEY, OHIO



OPERATION: CHASING LEAD SCREW

MACHINE: MONARCH HELICAL GEARED HEAD LATHE

MATERIAL 40/50 CARBON STEEL

SPEED: 40' PER MINUTE

FEED: 4 THREADS PER INCH

CUTTING LUBRICANT: 1 PART SUNOCO TO 15 PARTS WATER

THE outstanding successes by machine tool manufacturers, when using Sunoco Emulsifying Cutting Oil, are due of course to the unusual virtues of the product:

1. Mixes easily and stays mixed.
2. An ideal refrigerant as well as lubricant.
3. Acts as a perfect rust preventive.
4. System doesn't clog up.
5. Renewals of oil systems necessary much less often.
6. Permits higher speeds and heavier cuts with better finish.
7. Contains no animal or vegetable fat; therefore will never turn rancid.
8. Contains no rosin or rosin oil.
9. Workmen like it because it keeps hands in better condition

SUN OIL COMPANY, Ltd., Montreal

SUNOCO

CUTTING OIL

Branches

JACKSONVILLE	PITTSBURGH	TOLEDO
MIAMI	PROVIDENCE	TORONTO
MONTREAL	READING	TRENTON
NEWARK	ROCHESTER	TULSA
NEW YORK	SYRACUSE	WILMINGTON
PHILADELPHIA	TAMPA	

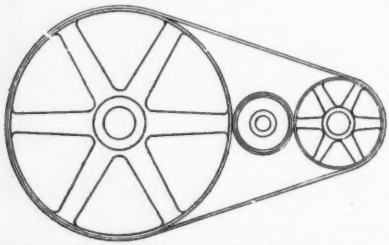
Ideas From Readers

This department is a clearing-house for ideas. If there is a "kink" or short-cut in use in your shop, send in a description of it. We will pay $5 for each one published.

Eliminating Bearing Pressure On Short Belt Drives

By R. H. KASPER

SOME time ago the writer observed an unique arrangement of a short belt drive, which is described here with the idea that it may be of value to other readers. The driving and driven pulley were belted together in the usual manner, but between the pulleys, and forming contact with both, an idler pulley was inserted as shown. The idler pulley, which was faced with leather, revolved freely on a stud that had been threaded into a convenient part of the machine. The idler was just large enough to fit tightly between the other two pulleys without springing the shafts. This arrangement made it possible to use a tight belt without springing the shafts or putting an unusual load on the bearings, as the side pressure developed by the tension of the belt was taken equally on both sides by the idler pulley.



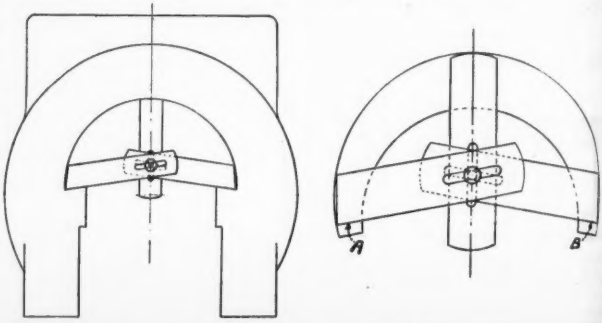
An idler pulley makes possible a tight belt on a short belt drive.

Caliper Gage for Laying Off Driving Box Brasses

By H. H. HENSON

AS locomotives have increased in size, it has been found increasingly difficult to keep the larger driving box brasses tight in the boxes and the question has been raised many times, as to what kind of gage is most practical and gives the best results in calipering the shell or box to lay off the brass.

The gage shown in the drawing is a very accurate tool. It is made of thin sections of sheet metal, held together by a thumbscrew and nut. Washers prevent the screw and nut from cutting into the sections, and aid in clamping. It is used in the same manner as an ordinary inside caliper and with a little practice the machanic can lay off a brass to the desired tonnage without any trouble. The gage can be made by any toolmaker at a nominal cost, and will give better results than any other ever seen by the writer.



Caliper Gage for Laying Off Driving Box Brasses.

A Simple Method of Checking Furnace Temperatures

By R. H. KASPER

IN a recent hardening test on tool steel, a metallurgist requested that an old twelve-inch mill file, or something similar, be at hand in order that he might check the furnace. Though the writer could not imagine how an old file could be used for this purpose, the procedure followed by the metallurgist proved the simplicity and accuracy of the test.

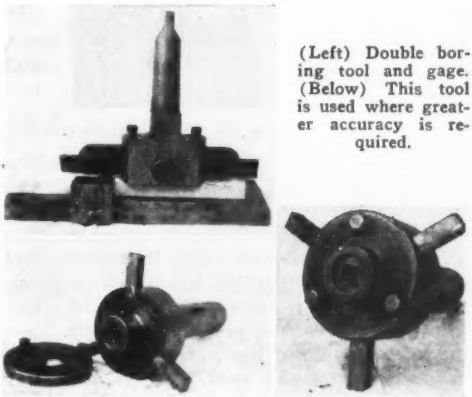
One end of the file was first broken off and placed to one side. The balance of the file was then broken into several pieces and the pieces were placed at different points on the floor of the furnace, which was then brought up to a temperature of 1,400 degrees Fahrenheit, as indicated by the pyrometer. One piece at a time was then removed from the furnace, quenched in water and then broken. The fracture of each piece was then compared with the fracture of the original piece. The work to be hardened was then placed in the same position in the furnace as the piece of file of which the fracture more nearly coincided with the fracture of the original piece.

The explanation is as follows: a pyrometer theoretically indicates the temperature inside the furnace. Actually, it merely indicates the temperature in the proximity of the thermo-couple; it is possible for the temperature at various points in the furnace to vary fifty degrees above or below the pyrometer indication, due to unequal fuel distribution. Files are made of a straight carbon tool steel of 1.30 to 1.40 per cent carbon content, which will harden with a silky grain structure entirely through a section of about ¼ inch thickness at 1,400 degrees Fahrenheit. Due to the high carbon content of the steel, difference in grain structures produced by different temperature applications is quite pronounced. The piece of file which hardens with the same grain structure as the piece held for comparison proves that the furnace at that point had been at a temperature of 1,400 degrees within a margin close enough for practical purposes. Though this test will become more conclusive after a few trials, it tells its story, even to the inexperienced eye.

Two Handy Boring Tools

By J. H. HAHN

THE illustration shows two very handy tools that are now in use in a locomotive repair shop, but which can be used to advantage in any shop doing heavy work. One of the tools (upper left) carries two toolbits, which are set to size by the use of the gage shown just below the tool. The plug in the center of the tool has a tapered point, and the inner ends of the toolbits are ground to the same angle. To adjust the tools, the two setscrews that lock the toolbits in place are loosened, the gage is set to the size to which the hole is to be bored, the toolbits are adjusted to the gage with the rear ends of the toolbits in contact with the conical plug, and the setscrews are tightened. The gage is graduated, and can be set for any size within the range of the tool.



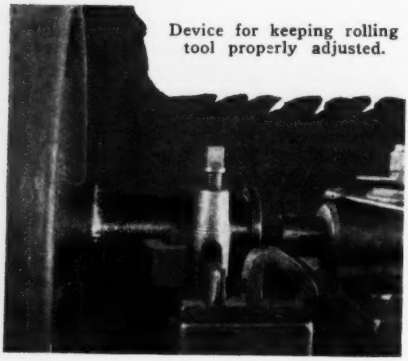
(Left) Double boring tool and gage. (Below) This tool is used where greater accuracy is required.

The tool shown in the two lower photographs is also adjusted by means of a central plug, and is intended for use where a greater degree of accuracy is required. The tool is shown at the left with the clamping plate removed. The tool-bits are adjusted by loosening the three capscrews and turning the adjusting plug in the center. The tool is used on either boring machines or drill presses.

Adjustment for Rolling Tool

By Jos. C. Coyle

IN USING a rolling tool to finish car journals, in the Denver & Rio Grande shops, trouble was experienced in keeping the roller square with the surface of the work. As the usual method of squaring up the tool, at intervals, was and always has been unsatisfactory, the device shown here was originated. The device consists of a piece of 1 x 2-inch steel, 18 inches long, about two-thirds of which is bent into a triangular shape, as shown. A setscrew projects through the vertical side of the triangle. When in position on the tool post of the lathe, the tool rests on the straight section of the piece, while the setscrew bears against the side of the tool. By adjusting the setscrew, the tool can be located in position so that a perfect contact can be secured and maintained as the roller traverses the work. The device itself is kept from slipping, as pressure is applied by two dowel pins in the horizontal part, which fit into corresponding holes in the upper side of the tool block.



Device for keeping rolling tool properly adjusted.

Use of X-Ray

(Continued from page 11)

less than the cost of the labor up to the point at which the defects were discovered, and if they had been a trifle deeper in the casting they might not have been discovered until the casting failed in service.

The chief advantage of the use of the X-Ray in the metal-working field lies as much in the ability to locate defects in the individual piece as in the ability to take steps to prevent their recurrence. The discovery of similar defects in a number of castings of the same kind may lead to different methods of gating, thus either eliminating the defects or placing them where they will do no harm. A large manufacturer of radio tubes inspects the tubes by means of the radiograph, in order to discover whether the spacing between the grid and the filament is correct. A manufacturer of electrical apparatus in which a heating unit is used radiographs the units, at intervals, to discover whether the method of assembling the units is preventing the possibility of short circuits. The first units inspected in this manner were in such bad condition that new methods of assembling were developed, eliminating the trouble almost entirely, and assuring the production of a high-grade article.

It is such tools as these that science is placing in the hands of industry to aid it in meeting the ever-exacting demands that are continually being forced upon it by the public.

Barnes Upright Drills

Barnes 22½-inch Stationary Head Drill with Silent Chain Motor Drive

With Stationary Head—
15, 20, 22½, 25-inch swing.

—

With Sliding Head—
22, 26, 28, 34, 42, 50-inch swing.

—

Gang Drills—
20 to 26-inch swing.

Barnes Upright Drills are made in a range of sizes from the 50-inch swing, required in the railroad shop, to the 15 and 20-inch sizes used in the small machine repair shop and garage service.

Arranged for Silent Chain or Belted Motor Drive. With or without Power Feed.

Write for Our Circulars Giving Complete Information

W. F. and JOHN BARNES CO.

ROCKFORD, ILLINOIS

Upright Drills Screw Presses
Horizontal and Vertical Production Drilling and Boring Machines

MODERN Machine Shop

HOWARD CAMPBELL - - *Editor*

What's the Answer?

THE latest theory of students of economics is that our national prosperity is based largely upon the high wages and comparatively short hours enjoyed by the workmen of this country. Henry Ford says, in the "Saturday Evening Post," "When people work longest and with least leisure, they buy the fewest goods. No towns were so poor as those of England where the people, from children up, worked fifteen and sixteen hours a day. The man who worked fifteen hours a day * * * had no time to cultivate new needs. No industry could ever be built up by filling his needs, because he had none but the most primitive.

"It is quite generally believed that the introduction of machinery to do work formerly done by men creates unemployment. That, however, is not the case. One of our principles has been never to have a job done by hand if it could be better done by a machine. We have been displacing men by machines as rapidly as we know how. Yet in thirty years our pay-roll roster has gone from three men to more than a hundred thousand.

"The more well-paid leisure workmen get, the greater become their wants. They have the leisure to enjoy life and the wherewithal to finance that enjoyment. A workman would have little use for an automobile if he had to be in the shop from dawn until dusk. And that would react in countless directions, for the automobile, by enabling people to get about quickly and easily, gives them a chance to find out what is going on in the world—which leads them to a larger life that requires more food, more and better goods, more books, more music, more of everything."

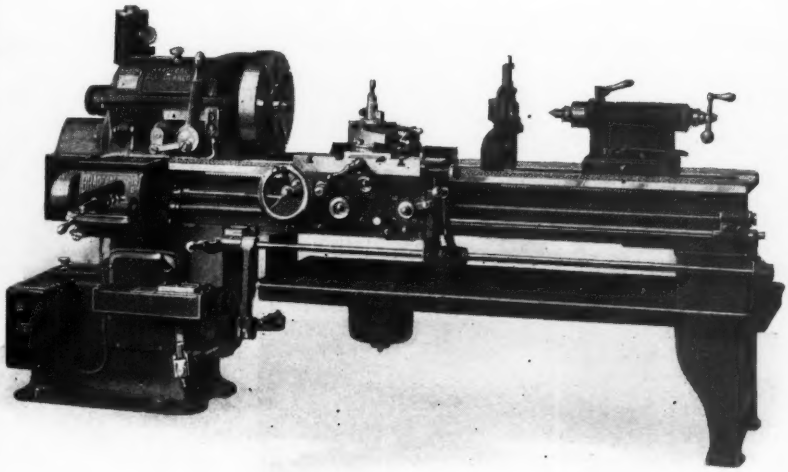
Just where the dividing line should be to afford the maximum of production, minimum of costs, and maximum of purchasing power, is affording a basis for an interesting study.

Standardization Eliminates Waste

ALTHOUGH the (then) Secretary of Commerce Hoover's program for the elimination of waste in industry is now a matter of history, it should serve as a mark for designing engineers to shoot at for many years to come. There is still room for reduction of waste by the elimination of odd sizes in standard units and parts, and a considerable amount of good can be accomplished along this line if machine designers will acquaint themselves with the available types and sizes of commercial machine units such as motors, clutches, pumps, and so on, before specifying the dimensions of such units to be used on new products.

Manufacturers of standard units will, of course, build special sizes if the order is large enough, but the machinery builder who is turning out from 50 to 100 machines per year can hardly expect a parts manufacturer to tool up for an order of fifty pieces and he may, therefore, be limiting himself as to choice of design, all for want of a little foresight. Every manufacturer of pumps, clutches, drives, or other parts has his own standard sizes, and the wise machine designer will look over the entire range of designs and sizes before completing specifications on a new machine.

They Must Be Good!



BRADFORD LATHES

are made in both all geared motor drive, and cone pulley types in sizes from 14″ to 50″ inclusive.

Write for Catalog

ORDERS for replacement parts and requests for service are so few and far between that we know the thousands of BRADFORD installations throughout the country must be good.

No news is good news in the machine tool business, for machine buyers are not silent sufferers when equipment falls down, and on more than two thousand BRADFORD installations we have not as yet been called upon to furnish a repair part. Such performance proves—

Bradford Superiority

THE BRADFORD MACHINE TOOL CO.

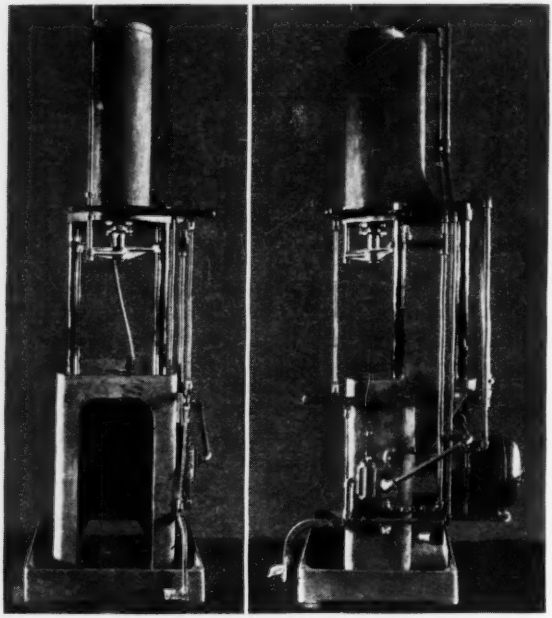
659 EVANS STREET **CINCINNATI, OHIO**

Precision Lathe Builders Since 1840

New Shop Equipment

American 4-Ton Hydraulic Broaching Machine

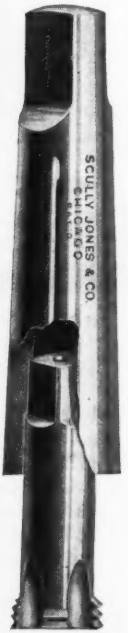
A 4-ton capacity hydraulic broaching machine, shown in the illustration, has been developed by the American Broach & Machine Co., Ann Arbor, Michigan. The machine is of tie-rod construction, with a work table 24 inches wide at a height of 40 inches from the floor. The dimension of the clear space from the front of the tie-rods to the center of the ram is 4 inches, and the maximum dimension between table and ram is 23 inches. The machine has a 4-inch bore, and an oil tank is cast in jacket form around the cylinder.



American V-4 Hydraulic Broach.

The machine is equipped with a balanced piston valve and can be supplied with either a piston valve, giving full pressure in either direction, or with a slip stem valve. With the latter valve, the machine is ideal for straightening, as it gives the machine a flexible control and makes it possible to obtain any pressure desired, from 0 to the maximum capacity, by the operation of the foot treadle. This construction makes the machine ideal for straightening, assembly work, and broaching operations. Hand lever control is also provided. The ram always automatically returns to the top of the stroke upon release of the operating lever. Adjustable knock-off stops are provided, which can be set for any desired stroke. The end of the ram is tapped 2 in. 8-Pitch.

The machine is intended to be motor-driven with a 5 h. p. motor, operating at 1,200 r. p. m. The ram has a downward speed of 18 ft. per min., with a return speed of 24 ft. per min. The pumping unit is of the internal gear type. The amount of floor space required for the operation of the machine is four feet wide by five feet deep. The overall height required for operation is ten feet, and the weight of the machine is 3,000 pounds.



"DRIVE BY THE SQUARE" "CENTER BY THE SHANK"

WITH SCULLY-JONES

"WEAR-EVER" TAP CHUCKS

1. **One-piece tool.**
2. **Better Work.**
3. **More Tapped Holes.**
4. **Less Tap Breakage.**

* Section removed to show position of tap in chuck.

This tool is making money for big and little concerns wherever used.

STOCK SIZES of **"Scully-Jones"** Chucks ranging from No. 0 to No. 5 Morse Tapers drive all size straight shank tools up to 1½" diameter, will be gladly sent on approval.

Complete Specifications in our Small Tool Catalog No. 36, which describes our complete line of production tools. A valuable handbook for any machine shop.

SCULLY-JONES & CO.

TOOL DIVISION

1909 S. Rockwell Street CHICAGO, ILLINOIS

Factory Representatives and Local Stocks

DETROIT, MICH.
Gross & Heming
1502 David Stott Bldg.

CLEVELAND, OHIO
Cleveland Tool & Sup. Co.
1427-37 W. Sixth St.

NEW YORK CITY
L. C. Biglow & Co., Inc.
250 W. 54th St.

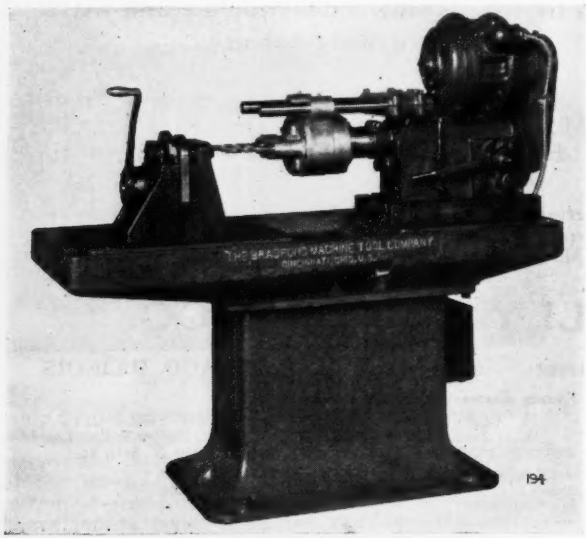
West Coast Representative
Jos. C. Fletcher
661 Folsom St., San Francisco

BUFFALO, N. Y
R. C. Neal Company, Inc.
76 Pearl St.

Bradford Automatic Drilling Machine

The Bradford Machine Tool Company, 659 Evans Street, Cincinnati, Ohio, has introduced a general purpose automatic drilling machine, consisting of one of the Bradford single automatic units, mounted horizontally. The spindle is arranged so that various types of auxiliary multiple spindle drilling attachments may be mounted, as shown in the illustration.

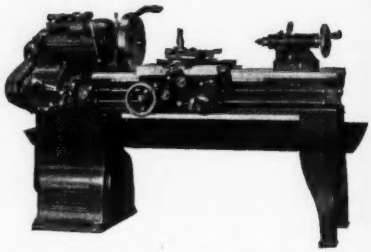
The set-up shown is in use in one of the large automobile plants for reaming four 5/8-inch holes, 1 1/8 inches long, in valve lifter guide brackets. The pieces are of cast iron. Operating at a spindle speed of 467 r. p. m. and a feed of .018 inch per rev., the piece is machined complete, floor to floor, in 36 seconds. The cam action provides a rapid approach of 3 inches, feed for 2¼ inches, and rapid return of 5¼ inches. The tool removes .015 inch of stock. On the operation described, one man operates two machines simultaneously.



Bradford Automatic Drilling Machine.

Rockford Geared-Head Lathe

The Rockford Machine Tool Company, 2410 Kishwaukee Ave., Rockford, Ill., is now furnishing its latest



Rockford Geared-Head Lathe.

model of "Economy" lathes in the geared-head types, driven by a single pulley. This geared head provides 12 forward spindle speeds by the use of only 12 gears. The gears are of large diameter and coarse pitch, and are cut from high-grade alloy steel forgings which run continuously in an oil bath.

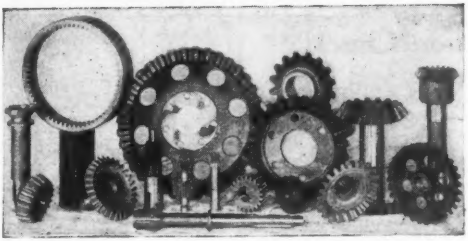
The 12-inch and 14-inch lathe headstocks are equipped with Timken tapered roller bearings on all driving shafts, the spindles running in high-grade bronze. The 16-inch headstock is Timken equipped throughout, including the spindle bearings.

The user has the option of any standard make of driving motor, to use either direct or alternating current, with a maximum constant speed of 1,200 r.p.m. The motor is mounted on an adjustable bracket in

Spur - Spiral - Bevel - Worm

Cut Gears — Any Quantity — Any Material

From Blue Prints or Specifications Demanding Close Tolerance



We Specialize in Aircraft and Other Precision Gears

CONTRACT WORK : AVERBECK SHAPERS

STEEL PRODUCTS ENGINEERING CO.

1160 WEST MAIN STREET SPRINGFIELD, OHIO

Wherever Centers Are Used

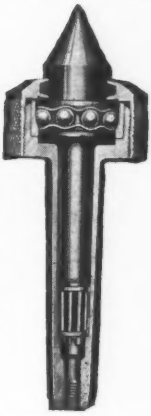
NIELSEN LIVE CENTERS

Lower Production Costs

These thoroughly tested centers have the required accuracy for all turning and grinding jobs. They are suitable for high or low speeds, light or heavy loads—and have been used as standard equipment for many years in prominent plants throughout the country.

Tungsten Carbide tools hold no terrors for "Nielsen" Centers. They are guaranteed against defects in material and workmanship.

Send For Circular



NIELSEN, INC.

LAWTON MICHIGAN

the cabinet leg. Provision is made for keeping the belt at the correct tension at all times, and the drive is extremely quiet, flexible, and free from trouble. Power is transmitted from the belt pulley to the headstock through a Twin Disc Clutch, having a brake for stopping the spindle instantly.

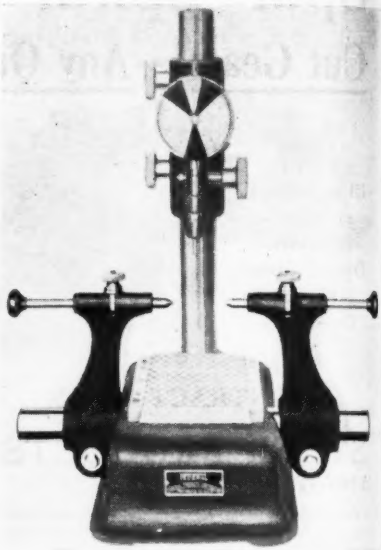
Apex Friction Chuck

Apex Friction Chuck

The illustration shows the Apex Friction Chuck with hexagon shank, intended for use with electric tools for nut setting, screw driving, stud setting, and so on. The chuck will be furnished with a special shank to fit any electric or air tool, the friction being set so that it will slip when the nut is set. The friction consists of a multiple disc clutch which slips without jar or vibration. The tool is easy on the operator and saves wear on electric tools. This tool will be furnished to take the standard Apex nut setter, stud setter, or other Apex tools, or with a hexagon hole to take other makes of accessories.

Federal Direct-Reading Comparator

A direct-reading comparator, intended principally for use in the inspection of duplicate parts in large quantities, has been placed on the market by the Federal Products Cor-



Federal Direct-Reading Comparator

poration, Providence, R. I. The tool consists of a substantial base, carrying a work-plate and a vertical shaft or standard upon which is mounted a Federal dial indicator. A bar which extends through the base serves as a mounting for either a pair of V-blocks or a pair of centers. The blocks are made with solid hardened and ground rollers, 7½ inches long, and held by heavy supporting brackets, which eliminate all possibility of spring. The centers are adjustable for a maximum range of 8 inches, and are equipped with locking clamps and supported with rigid brackets. The maximum range with the V-blocks is 8 inches, and the maximum swing possible with the centers is 3¾ inches.

The head that carries the dial indicator is locked in position by means of two screws, and a fine screw adjustment is provided for the indicator, making it unnecessary to revolve

"HOPKINS" PREFERRED EQUIPMENT

—another

"Hopkins"

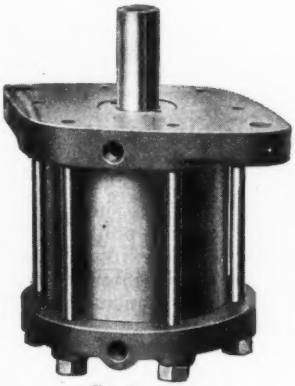
AIR CYLINDER

(*Non-Rotating—Double Acting*)

THIS Tubular Type Cylinder, Style No. 2, is an unusually popular number among the several "HOPKINS" Cylinders.

It is available in any diameter or length.

Catalog and Complete Engineering Data on Request



Style 2

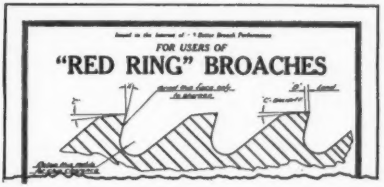
THE TOMKINS-JOHNSON CO.

620 MECHANIC STREET
JACKSON, MICH., U.S.A.

Also Manufacturers of Chucks, Die Sinking Milling Cutters, Work Stands, Special Equipment, Etc.

HOW MANY

DO YOU WANT?



An instructive chart on "How to Properly Grind Broaches" is now ready for distribution to broach users. Used as a guide, this "Red Ring" chart will assure maximum broach life and performance. The instructions are applicable to all makes of broaches.

We will gladly mail you any required number upon request. Mail the coupon *today*.

NATIONAL BROACH CO.

5 JUNE STREET

DAYTON OHIO

→*SEND COUPON NOW*←

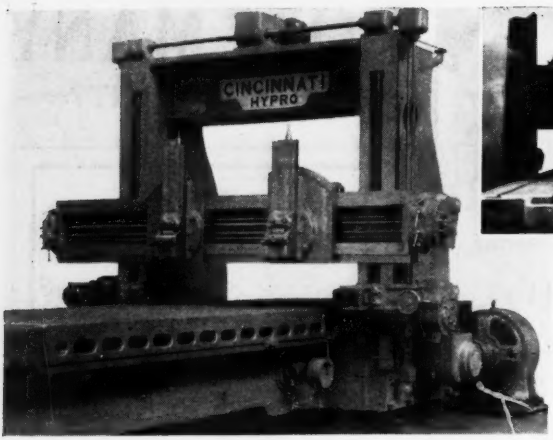
NATIONAL BROACH CO.
Dayton, Ohio

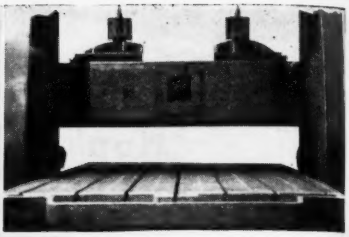
Kindly send me, without cost or obligation, ---------- "Red Ring" Charts, "How to Properly Grind Broaches."

Name----------

Firm----------

Address----------





(Left) — Cincinnati 96-Inch Hypro Planer. (Above)—View of Rail from Rear, Showing Built-In Torque Motor for Clamping the Rail.

the dial to obtain zero at a given point. A "limit reading dial" is also provided, with a V opening which can be set to any desired limits, aiding in quick inspection. The complete tool, with V-blocks and centers, weighs 113 pounds.

Cincinnati 96-in. Hypro Planer

The Cincinnati Planer Company, 3100 South Street, Cincinnati, Ohio, has augmented its line by the addition of a 96-inch planer which embodies all of the standard features that have been developed in the past. A harp clamp has been added to the saddles, the construction of which eliminates any possible chance of the harp pulling away from the saddle when the slide and tools are extended below the bottom of the rail.

A narrow guide which has been added to the saddles on this machine prevents springing, and electric rail clamps have also been added, as shown in the illustration. A small torque motor is placed inside the rail, and a self-contained unit operates the two clamps on the inside. The power clutch is disengaged and the clamps are released by the operation of a push button. With this interlock, it is impossible to raise and lower the rail while the rail is clamped. The standard mechanism has been simplified to eliminate all shafts and other details, this mechanism being controlled by the master switch.

A parallel drive box, which has been placed on the right hand side of the housing, contains two hardened chrome nickel spiral bevel gears. The gears run in oil, and the shafts are mounted on ball bearings.

Hisey-Wolf Texdrive Buffing and Polishing Machine

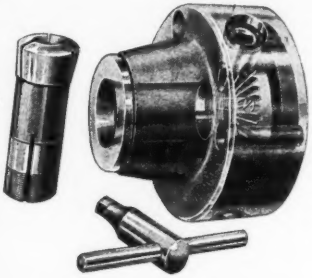
The illustration shows a Hisey-Wolf buffing and polishing machine, equipped with Texrope drive. This type of drive is intended to insure perfect power transmission without slippage. The base of this machine is a one-piece casting, designed with the bulk of the weight at the base, thus eliminating vibration. The spindle is of nickel steel, extra large, accurately machined to exact diameter to insure perfect balance. The bearing boxes are keyed to the column to insure rigidity of spindle and accuracy of alignment. Two ball bearings of ample proportions are provided for each end of the spindle, al-

You will want this

New

Cushman Nose Type COLLET CHUCK

If You Machine Bar Stock



THE chuck offers no obstruction to the hole and has a capacity of 1¾" It is mounted on the spindle by bolting to a plate in the same way that a lathe chuck would be.

The body is a solid piece of steel, heat treated and ground perfectly true on both outer and inner surfaces.

Two ground bearings in the collet provide for accuracy in holding the work.

Discs and pinions are of a fine grade of alloy steel, carefully heat treated.

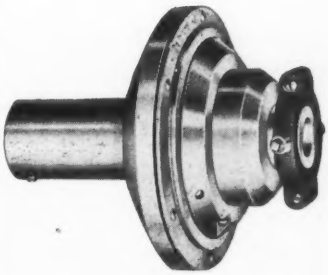
The special type collets can be obtained in sizes from ½" to 1¾", inclusive, from us or from any distributor.

Write for Bulletin No. 88.

THE CUSHMAN CHUCK CO.

805 Windsor Street

HARTFORD CONN.



In what other clutch will you find these features?

Enclosure, balance, centripetal action, easy engagement, instant release, drag free idling, micrometer adjustment and power capacity.

"To buy any other clutch, when the Conway Disc is available under your specifications, is to invest in obsolescence."

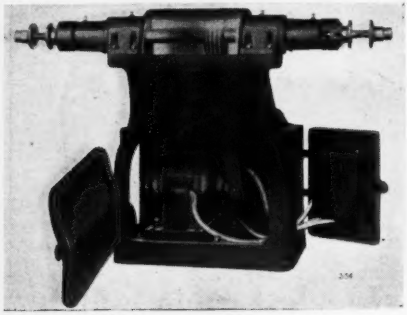
Our engineering department will be glad to consider your starting and stopping problems, and give you the benefit of an experience dating from 1904.

The Conway Clutch Co.

1959 W. 6th St., Cincinnati, Ohio

The Conway Disc is a Splendid Clutch

though Timken bearings will be supplied, if desired, without extra charge. The bearings are lubricated by means



Hisey-Wolf Texdrive Buffing and Polishing Machine.

of oil chambers and conveniently-located cups.

The motor is mounted horizontally on a 4-point bearing on a base that is attached to the main frame. The base has planed ways on which the motor slides, when necessary to adjust it for belt or rope tension. The switch is mounted inside the base, and the starting button is mounted flush in the top front of the column.

Motor Driven No. 1 Universal Grinding Machine

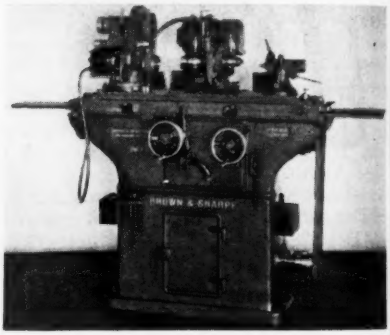
The Brown & Sharpe Mfg. Co., of Providence, R. I., has recently announced a further addition to its line of Universal Grinding Machines—the Motor Driven No. 1 Universal Grinding Machine.

The machine is similar in design to the belt driven No. 1 Machine except that, like the Motor Driven No. 2, 3, and 4 Machines, it is equipped with three constant speed balanced electric motors.

One of the important features of this machine is the reversible wheel stand motor which is reversed when the machine is used for internal grinding with the Internal Grinding Attachment. Hence, it is not necessary to swivel the wheel stand platen to a reverse position. The motor may be reversed by means of a convenient lever and the internal grinding attachment spindle is driven in the proper direction.

The base is cast in one piece, and is supported at three points. The bed is long in order to support the table at its extreme travel. The cross feed slide is counterweighted to eliminate backlash and the pull may be reversed for internal grinding.

The motors are integrally mounted on the headstock, on the wheel stand,



B. & S. Motor-Driven No. 1 Universal Grinding Machine.

and at the rear of the machine, and are carefully balanced before the machine leaves the factory. The machine is furnished fitted with motors only.

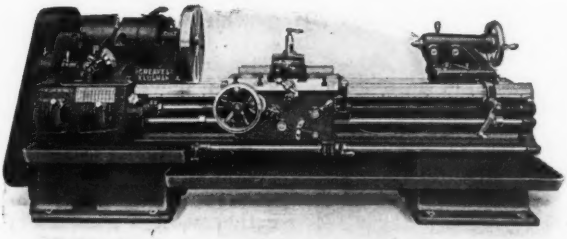
Bolender Gear-Grinding Chuck

A chuck that is designed especially to hold gears for internal grinding is now being marketed by the City Machine & Tool Works, 1521 East Third Street, Dayton, Ohio. This chuck, known as the Bolender Gear Grinding Chuck, is shown in the illustration.

G-K Single Lever Control

Simplifies Operation

Flexible Motor Drive

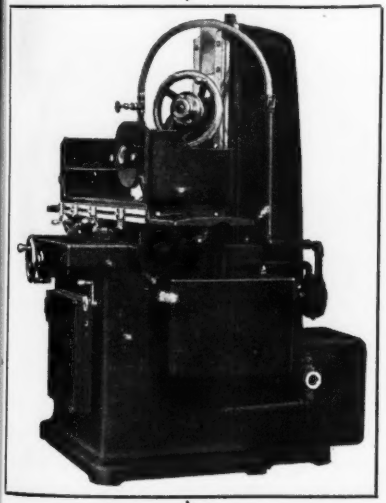


Built In Six Sizes

Any spindle speed of an extremely wide range, can be instantly selected through a single lever. An index plate shows at a glance how to obtain the desired speed.

Simplified operation means greater production. Many other G-K time and cost saving betterments are described in the G-K Catalog. *Write for your copy today.*

The GREAVES-KLUSMAN TOOL Co., Cincinnati, O.



GRAND RAPIDS

SURFACE GRINDERS

(Built in 4 sizes)

Oil Gear Hydraulic Feeds
Motor Driven — Belt Driven
Wet Grinding—Dry Grinding

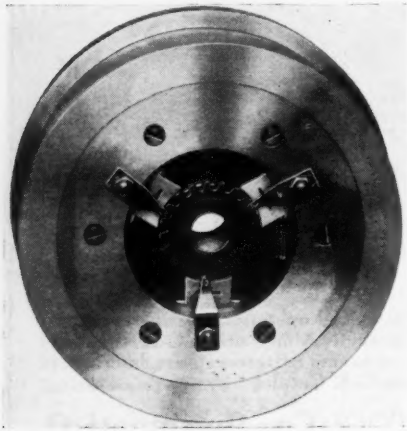
Combine Quality and Quantity Production by Installing

GRAND RAPIDS GRINDERS

Bulletin on Request

GALLMEYER & LIVINGSTON CO.
348 Straight Ave., S. W.
GRAND RAPIDS, MICH.

The chuck is so designed that it can be quickly loaded from the front without the necessity of using adapters, and holds the gear so that the bore is ground concentric with the pitch



Bolender Gear Grinding Chuck

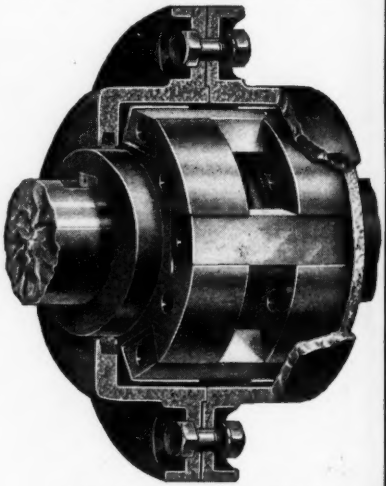
line of the teeth. The gear is held by three hardened and ground interchangeable jaws, all working surfaces of which are positively lubricated and enclosed at all times. By protecting the working parts against dust, water, abrasives, etc., in this manner, the life of the chuck is multiplied. An additional provision is made for long life by designing the chuck so that changes of bearing surface can be made.

All types of irregular work can be ground in this chuck by using quick-change special chuck jaws which hold the work to a tolerance of .0005 inch. The chuck is lubricated and sealed through one Zerk oiler, the one connection making it possible to pack the entire mechanism with lubricant and eliminating the possibility of water or compound entering the chuck.

Nicholson Flexible Coupling

A flexible coupling that has been designed to compensate for any case of misalignment, within practical limits, and to permit a liberal amount of lateral float, has been placed on the market by W. H. Nicholson & Company, 136 Oregon Street, Wilkes-Barre, Pennsylvania. The coupling consists of two steel hubs which are keyed to their respective shafts, and in which dove-tail slots are cut to receive floating steel keys. Both the side surfaces of the slots and the floating keys are case-hardened, reducing wear to a minimum at these points. The keys are the working parts of the coupling, and are enclosed in a malleable iron casing made in two halves and bolted together with a gasket between. This casing is firmly secured to the fixed hub, causing it to run absolutely true, although the shafts may be running out of line with each other. A floating felt washer in the floating hub side keeps dust and dirt out and the oil in.

When in operation and connecting two shafts which are misaligned, the keys have a slight rocking motion during each revolution which pre-



Nicholson Flexible Coupling.

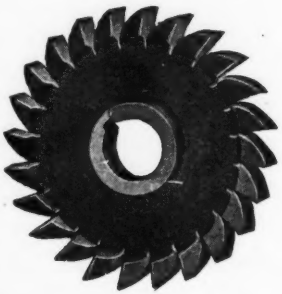
vents the wear from becoming localized. The pressure maintained by centrifugal force maintains on oil film

Better Cutters at half price

by the

"EASTERN PROCESS"

of Recutting



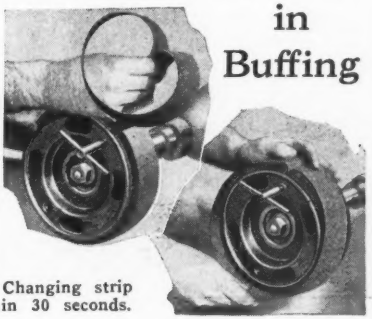
SEND us your worn-out milling cutters—we will recut them at half the cost of new cutters, and they will give you better service than they did when new.

By the "Eastern Process" your cutters are recut, without annealing, with a reinforced undercut tooth, having greater chip clearance, and a smooth ground finish. We pay express charges both ways, and guarantee our workmanship in every respect. You will save 50 per cent on your cutter costs —try it TODAY!

Eastern Cutter Salvage Corp.

43-45 Freeman Street Newark, N. J.

Amazing New Development in Buffing



Changing strip in 30 seconds.

THE new, safe, high speed Quick-As-Wink Buffing Wheel has eliminated all disadvantages of rag-buffing. Its use has cut buffing costs square in half.

ABSOLUTELY SAFE AT ANY SPEED

Each wheel is carefully balanced, strongly built and tested at 8,000 r.p.m. Operation guaranteed to be safe, continuous and smooth at any speed. Complete buffing surface is brought into action.

BETTER, FASTER WORK WITH COSTS CUT 50%

The special feature of the metal clip which holds the ends of the abrasive cloth together, permitting replacement of strips in 30 seconds' time, as illustrated above, prevents lost motion, speeds output and produces better finished work. Every wheel guaranteed.

WRITE FOR FREE BULLETIN

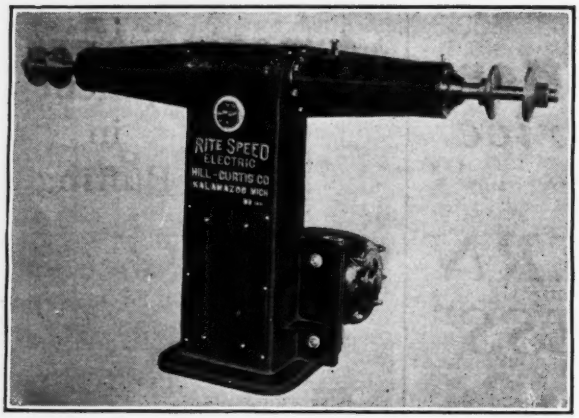
Complete details, description and prices will be mailed on request. If possible, send samples of finished and unfinished work.

Sizes: 6" and 8" diameter.
Face: 2½" and 3½".
Arbor Sizes: ½" to 2".
Speeds: 3450 to 5000 R. P. M.
Abrasive Strips: 24 to 320 grain.

C. B. HUNT & SON

639 McKINLEY AVE., SALEM, OHIO

Quick-As-Wink



Hill-Curtis Wide Swing Electric Polishing and Buffing Lathe

between the floating keys and the slots, thus reducing wear to a minimum and assisting the hub to float freely. The floating keys remain noiseless, the centrifugal action keeping them properly seated and quiet. The coupling requires oiling only about once a year.

Hill-Curtis Wide Swing Electric Polishing and Buffing Lathe

The Hill-Curtis Company, of Kalamazoo, Michigan, has recently added to its line of grinding, polishing, and sawing machinery a "Wide Swing Electric Polishing and Buffing Lathe." This machine was designed primarily for buffing automobile fenders, but is suitable for a wide range of work requiring maximum working room for two operators. The spindle, 80" overall, can be driven at any desired speed, and is designed with a multi-V belt drive.

The motor, it is said, will withstand overloads of 100 per cent rated capacity. It is mounted on the back of the pedestal, and is equipped with an air cleaner, which cleans all the air reaching the motor. Push button remote control, automatic starter, thermal overload protection and spindle lock are standard equipment. Either Timken Roller Bearings, or Fafnir Ball Bearings are optional. The machine can be furnished with either 3, 5, 7½, 10 or 15 HP capacity motors, for either alternating or direct current.

Baumbach Die-Set Catalog

The E. A. Baumbach Manufacturing Company, of 1806 South Kilbourn Avenue, Chicago, Illinois, has issued a new catalog describing their complete line of automatically-oiled die sets and accessories. It is well illustrated, and includes dimensions and price tables of their complete line. Sent free upon request to the readers of this magazine.

Hollow Bored Forgings and Steel Shafts

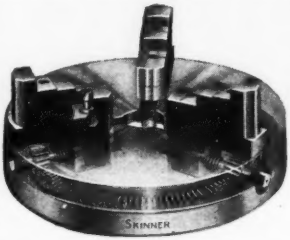
BORED STRAIGHT AND TRUE TO SIZE

You can be sure of prompt delivery, fair prices and high quality when you order forgings for piston rods, clutch shafts, lathe spindles, rams, hydraulic cylinders, etc., from us. Send prints for estimate.

AMERICAN HOLLOW BORING CO., 1035 W. 19th St., Erie, Penna.

SKINNER UNIVERSAL CHUCKS

GEARED SCREW—IRON BODY



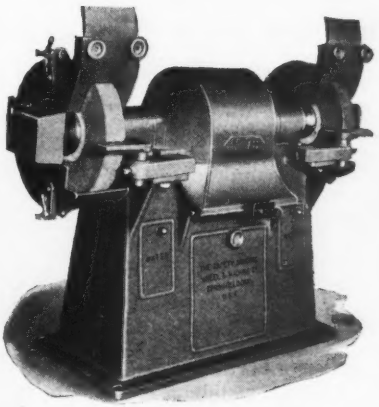
WITH STYLE "J" PATENT REVERSIBLE JAWS

THESE are the most accurate Lathe Chucks made and are recommended for use where accuracy is essential. The Skinner Geared Screw type of Chuck has extra strong gearing and a very powerful grip.

Universal Figure 300		Three Jaw	
Rated Size Inches	Will Hold Approximately, Inches	Order by These Numbers	List Price
3	3¾	303 J	$33.00
4	4⅛	304 J	36.00
5	5¾	305 J	41.00
6	7¼	306 J	48.00
8	8⅝	308 J	57.00
9	9½	309 J	64.00
12	12⅞	312 J	75.00
15	16⅝	315 J	105.00
18	18⅝	318 J	140.00
21	21¼	321 J	180.00
24	25	324 J	225.00
27	28½	327 J	265.00
30	31¾	330 J	345.00
36	37	336 J	400.00

THE SKINNER CHUCK COMPANY

NEW BRITAIN, CONN U.S.A



This Grinder

will pay for itself!

HERE'S the No. 75 SAFETY Motor-Driven Floor Grinder. It's strong, rugged and compact—new in design and construction—built for years of fast and economical grinding.

The No. 75 is designed for the hardest work. It takes any size wheel up to 18"x3½." The jars, jolts and strains of high pressure work are absorbed by the *base* of the machine. The bearings are mounted on the base and not from the motor frame. Grinders of the same type for larger or smaller sized wheels can also be supplied.

GET FULL INFORMATION

SAFETY TRADE MARK

This advanced type Grinder will pay for itself thru increased production and lowered grinding costs. Mail the coupon for complete information *today*. There's no obligation involved.

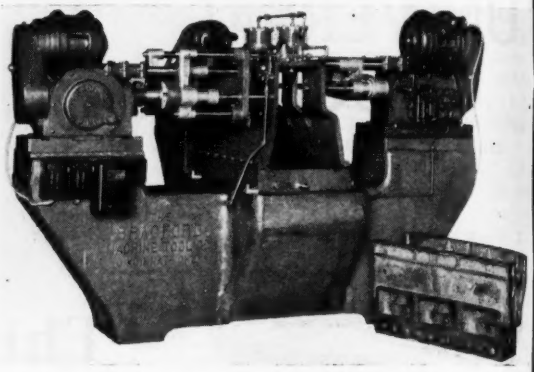
THE SAFETY GRINDING WHEEL & MACHINE CO.
2364 Columbus Ave., Springfield, O.
Please send me bulletin F-28-2 regarding your SAFETY Motor-Driven Floor Grinders.

(Name of Individual)

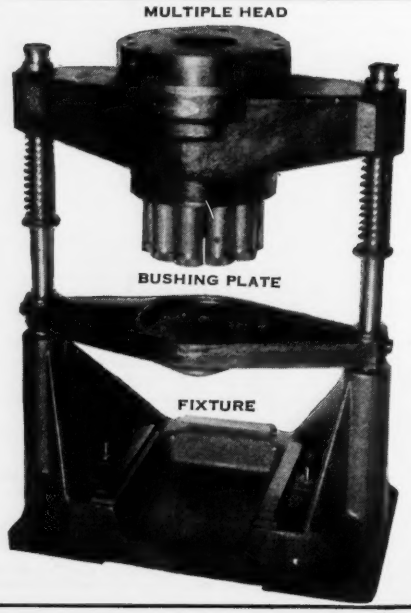
Pin this to your letterhead

Bradford Three-Way Reaming Machine

Seven water-jacket holes, in three sides of a cylinder block, can be reamed simultaneously by the use of the three-way horizontal machine shown herewith. The machine was built by the Bradford Machine Tool Co., 659 Evans Street, Cincinnati, Ohio, and was designed for use with a conveyor system. The operator slides each cylinder block from the conveyor onto the hardened guide strip at the bottom of the fixture, locating the piece in position by means of pins which enter dowel holes in the flange of the block. The dowel pins are raised into position and withdrawn by means of the hand-lever at the front of the fixture. Two air-operated rams, controlled by means of a valve on the top of the fixture, clamp the work. The feed mechanism of the heads is controlled by means of a valve at the side of the fixture. In the operation for which the machine was built, the water-jacket holes are



Bradford Three-Way Reaming Machine



Why Guess About Methods and Cost of Increased Production

"Krueger"

STANDARDIZED

Multiple Head, Bushing Plate and Fixture } held in positive and perfect alignment for

Drilling, Reaming, Boring, Tapping

OUR SKILLED TOOL ENGINEERS

Will be pleased to furnish complete data and submit quotations on the equipment best suited to your purpose.

H. R. KRUEGER & CO.

439 EAST FORT ST., DETROIT, MICH.

OLIVER OF ADRIAN

Die Making Machines

save an average of 50%. Dies, templates, experimental parts, gages, etc. can be sawed out, filed and lapped on the OLIVER OF ADRIAN DIE MAKING MACHINE much easier, more accurately and in a fraction of the time ordinarily required for hand work.

Send for Bulletin

OLIVER INSTRUMENT CO.
1430 Maumee St. Adrian, Mich.

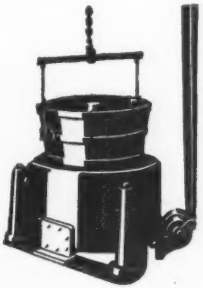
One
40" Tolhurst Chip Wringer

Will replace from three to six small machines—require but one operator, and thus

Cut your cutting oil budget.

Cut down labor cost.

Cut down power cost and investment.



WRITE FOR CATALOG TODAY

TOLHURST MACHINE WORKS, Inc., Troy, N. Y.
New York Office: 30 Church Street
Chicago Office: 8 So. Dearborn St.

STANDARD RIGHT SPEED BUFFERS

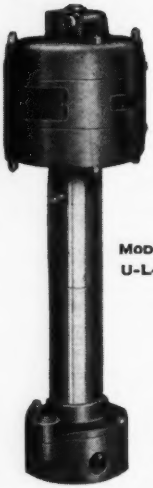
G. E. 40° Ball Bearing Motors. Push Button Control. Four S. K. F. Ball Bearings. Nickel Steel Buffing Spindle. Speed 2000 to 3000. Made in 4 sizes: 3, 5, 7½ and 10 H. P.

Angle Plate Grinders, Electric Drills, Grinding, Polishing and Buffing Machines in various types and sizes.

WRITE FOR CATALOG

THE STANDARD ELECTRICAL TOOL CO.
ESTABLISHED 1912 CINCINNATI, OHIO

"GUSHER"
Coolant Pumps



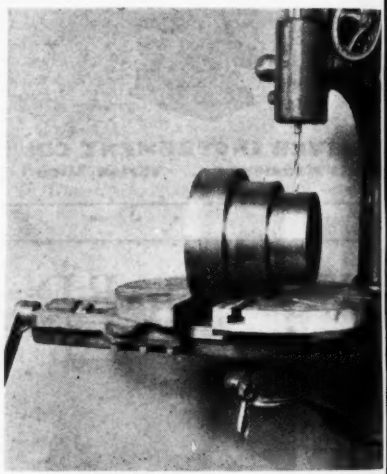
For every purpose and capacity. Simple in construction—efficient in operation.

The Ruthman Machinery Co.
Front and Pike Streets
CINCINNATI, O.

reamed to .943 inch diameter, approximately 1-32 inch of stock being removed from each hole. The spindle speed is 350 r. p. m. and on the block shown, the machine time is 16 seconds, handling time 14 seconds, and total time 30 seconds.

Combination Drill Table and Vise

A tool known as the "Combination Drill Table and Vise," manufactured by the Modern Machine Tool Company, of Jackson, Michigan, is said to



Combination Drill Table and Vise

save its cost every six months on labor alone. The design of the tool is similar to that of the ordinary round drill press table. The table is, however, divided in the center and mounted on a base in such a manner that one-half of the table can be moved back and forth by means of a square thread screw. Thus the table can be used as a vise as shown in the illustration. The jaws are fitted with steel plates to afford long wearing qualities. The "Combination Drill Table and Vise" will be

MAIL THIS

TO SOLVE YOUR CLUTCH PROBLEMS

[Furnished In Double Type As Illustrated or Single.]

ROCKFORD DRILLING MACHINE CO., Rockford, Illinois

IF THIS NEW

PULLMORE Industrial Clutch

MAKES POSSIBLE: { Extreme Compactness / Greater Clutch Efficiency / Fewer Adjustments / Ready Adaptability

MAIL US DETAILS

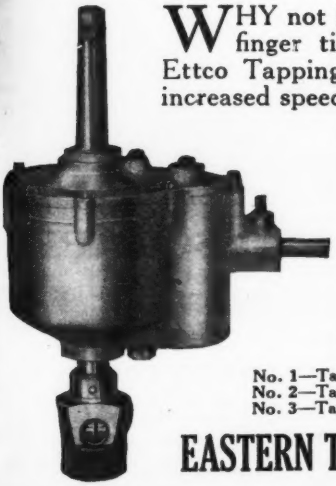
Name.....

Firm.....

Address.....

CUT HERE

IF YOU TAP HOLES—



WHY not have the feel of the tap right at your finger tips? A tap is a delicate tool. The Ettco Tapping Attachment taps delicately—with increased speed—That's the answer.

The ETTCO Tapping Attachment

is simple—nothing to adjust—if the tap sticks or hits bottom, the Ettco slips—the same action coming out. No clash of a positive clutch—just the smooth action of the patented leather lined cone clutch.

Sensitive :: Speedy :: Satisfactory

No. 1—Tapping Attachment, 3-16" in steel, ¼" in C. I....$35.00
No. 2—Tapping Attachment, 5-16" in steel, ⅜" in C. I.... 50.00
No. 3—Tapping Attachment, ½" in steel, ⅝" in C. I.... 80.00

EASTERN TUBE & TOOL CO., Inc. 596 Johnson Ave BROOKLYN, N.Y.

furnished with a shank turned to any specified size to fit the socket in the arm of a drill press. It is built in four sizes, 28", 19", 16", and 8" table diameter.

Three New Catalogs of U. S. Electrical Tool Co. Show Several New Items

In keeping with their plans for expansion in 1929, the United States Electrical Tool Company, 2471 West Sixth Street, Cincinnati, Ohio, have added several new items to their line. These tools are shown for the first time in three new catalogs which have just been published.

One of the new catalogs (No. 25) is devoted to more than 50 portable electric drills, screw drivers, valve refacers, grinders, and similar items and shows for the first time the new U. S. ¾-inch heavy duty drill, ¼-inch and ⅜-inch special drills, rotary saw, valve refacer, 4-inch portable grinder and 8-inch bench and floor grinder. The No. 26 catalog marks the initial appearance of the new U. S. Flexible disc sander and improved portable surface grinders, tool post grinders, angle plate grinders, and similar numbers.

In the new No. 27 catalog, which is devoted to heavy duty grinders, buffers and polishers, the U. S. Electrical Tool Co. now displays its new 20-inch and 30-inch high speed snagger, capable of 9,500 surface feet per minute. Many time and labor-saving improvements are shown, such as the new wheel guards. These guards are adjustable to wheel wear without disturbing stationary exhaust connections. The new catalogs can be obtained from jobbers or direct from the manufacturers.

When writing to advertisers mention MODERN MACHINE SHOP. The more we grow, the better editorial material we will be able to furnish through the columns of this magazine.

ECLIPSE TWO-PIECE CORE DRILLS

—thousands of them—are in daily economical use throughout the manufacturing industry. For machining holes 1-¾" diameter and up, in production, these tools are very economical.

Catalog No. 28 Upon Request

Sales Representatives in all large cities.

Deep fluting for chip clearance and rugged square taper drive means better performance.

ECLIPSE INTERCHANGEABLE COUNTERBORE COMPANY
DETROIT — MICHIGAN

This ANDERSON HAND SCRAPER

***will be sent to you for* 10 DAYS' FREE TRIAL!**

Don't waste time making your own. The blades are of just the right hardness. Cuts faster and lasts longer than any home-made scraper.

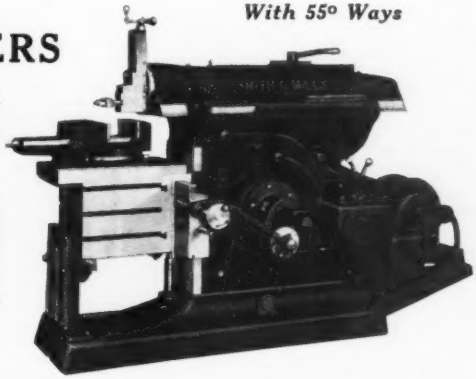
Price per doz., ¾", $26.00; 1", $27.00; 1¼", $28.00. ***Let us send you one on trial.***

ANDERSON BROS. MFG. CO. 1926 Kishwaukee St., Rockford, Ill

Shapers *that are* Producers!

SMITH & MILLS
HIGH SPEED
CRANK SHAPERS

"V"-TYPE RAM
With 55° Ways

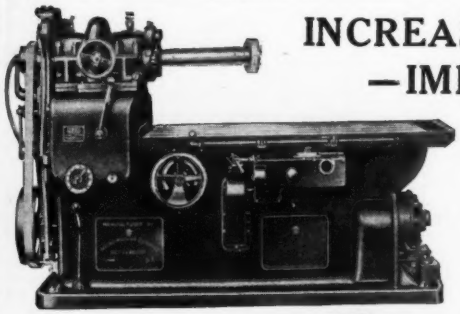


Designed for accurate work at high speeds, these machines will be found equally efficient on tool room work or production.

Made in sizes 12" to 32" stroke. 12",14",16",20" and 25" with Gear Box single pulley belt driven or motor drive, also 16", 20" and 25" B.G. cone drive with belt shifter. 32" B. G. all geared single pulley belt drive or motor drive.

Write for Catalog

The SMITH & MILLS CO., Cincinnati, Ohio



Micro Model "DG," a general utility grinder with slotted table to accommodate work mounting fixtures.

INCREASED PRODUCTION —IMPROVED RESULTS

BRIEFLY, these are benefits that accrue with the use of MICRO Internal Grinders. Incidentally, time and labor costs come down, too—a direct result of the surprising speed with which these machines handle the work.

Many improved features of design combine to make MICRO Grinders distinctly superior for large and small jobs that involve internal grinding. Submit your problems to our engineers.

GRINDERS Micro

MICRO MACHINE COMPANY

Bettendorf — MANUFACTURERS AND DESIGNERS OF *PRECISION GRINDERS* FOR ALL PURPOSES — Iowa, U-S-A

For Your Catalog Library

Check any of these useful publications that you want, write your name, firm name, title, and address on the margin, then tear out the page and send to Modern Machine Shop, 128 Opera Place, Cincinnati, Ohio. They will be forwarded to you promptly without cost or obligation. Please restrict your list to not more than ten.

Turret Lathes and Tools: Illustrated book describing Cincinnati Acme Turret Lathes and Screw Machines, and showing a variety of tools and fixtures for use with these machines. The Acme Machine Tool Co., 4955 Spring Grove Ave., Cincinnati, Ohio.

Broaching By Modern Methods: Equipment and tools for finishing round, square or irregular-shaped holes and surfaces by broaching are described and illustrated in a booklet that is issued free by the American Broach & Machine Co., Ann Arbor, Michigan.

Scraping By Power: Bearing surfaces can now be scraped with a power scraper that is quicker and easier than the old-fashioned hand method. The tool is described in a folder that is issued by Anderson Bros. Mfg. Co., 1926 Kishwaukee St., Rockford, Ill. Sent free on request.

Steel Furniture for the Shop: The complete line of steel furniture made by the Angle Steel Stool Co., Plainwell, Michigan, including steel stools and chairs, steel foremen's desks, lockers, tables, tool stands, machine tenders, shop boxes and pans, iron bar racks, trucks, bench legs, and bench drawers, is described and illustrated in Catalog "C," which is issued free to machine shop executives.

Stop Tap Breakage: A booklet that tells how to stop the breakage of taps, reamers, and other tools, by the use of a friction chuck, also how to use the chuck for setting studs or nuts, has been issued by The Apex Machine Co., 200 Davis Ave., Dayton, Ohio. Sent free upon request.

Machine Shop Accessories: Catalog B-27, issued by the Armstrong Bros. Tool Co., 328 N. Francisco Ave., Chicago, Ill., describes the line of tool holders, boring tools, wrenches, pipe tools, ratchet drills, lathe dogs, and other tools manufactured by this company.

Metal and Wood Saws: Catalog No. 20 describing saws of all kinds, for both metal and wood. 256 pages of descriptions of saws and sawing machinery. E. C. Atkins & Co., 402 S. Illinois St., Indianapolis, Ind.

Hobs and Milling Cutters: A complete line of milling cutters and hobs for cutting all kinds of gears, splines, sprockets and other forms is described in Catalog G, issued by the Barber-Colman Company, Rockford, Ill. Descriptions and illustrations of the Barber-Colman hobbing machine and hob-sharpening machines are included. Sent free on request.

All-Geared Drilling and Tapping Machines: A catalog describing in detail the various types of all-geared, self-oiling, drilling and tapping machines made by the Barnes Drill Co., 801-851 Chestnut Street, Rockford, Ill., will be sent free upon request.

Modern Drilling Equipment: Circulars describing the various types and sizes of Barnes upright drills, multiple drills and horizontal drilling machines made by this company have been issued by the W. F. & John Barnes Co., Rockford, Ill.

Automatic Oiled Die Sets: The automatic oiled die sets, die shoes, punch holders, leader pins, bolster plates, bushings, and other standard die parts made by the E. A. Baumbach Manfg. Co., 1806 S. Kilbourn Ave., Chicago, Ill., are described in Catalog No. 5, which has been issued by that company. Sent free upon request.

Bradford Precision Lathes: Precision Lathes for the tool room and for general manufacturing purposes, all-geared and cone types, belt or motor driven, are described and illustrated in a catalog that is issued by The Bradford Machine Tool Co., 657-671 Evans St., Cincinnati, Ohio. The catalog also includes descriptions of taper, relieving, turret and other lathe attachments. Sent free upon request.

Bradford Unit Type Drill Heads and Tapping Heads are described and illustrated in a bulletin published by the Bradford Machine Tool Co., 659 Evans Street, Cincinnati, Ohio. The bulletin also describes useful applications of these heads.

How to Sharpen Cutters: A series of leaflets, which describe and illustrate the correct methods to employ in sharpening all kinds of cutters, can be obtained, without charge, by addressing Brown & Sharpe Mfg. Co., Providence, R. I.

High Speed Drill Presses: A complete line of drill presses that can be run at high speeds with complete safety is described in catalog number 50, issued by the Canedy-Otto Manufacturing Company, Chicago Heights, Ill. This catalog also contains descriptions of other equipment manufactured by this concern. Sent free upon request.

Finishing Compounds: A booklet has been issued by the Carborundum Company, of Niagara Falls, N. Y., which describes the Carborundum Brand of Finishing Compounds. It also illustrates the results of using different grades of finishing compounds on the same surface. Sent upon request.

Electric Tools: The complete line of "The Cincinnati" Electric Drills, Grinders, Buffers, etc., manufactured by the Cincinnati Electrical Tool Company, Cincinnati, Ohio, is fully described and illustrated in their new catalog. Free upon request.

Gear Data: The Cincinnati Gear Co., Cincinnati, Ohio, has published Catalog D, which describes and illustrates the various types and kinds of gears made by this firm. The book contains photographs of the plant department, with descriptions of the equipment employed, and also includes a number of pages of valuable data and reference tables for machine shop use.

Centerless Grinding: Bulletins describing and illustrating the Cincinnati Centerless Grinders, methods employed, and principles involved, have been issued by the Cincinnati Grinders, Inc., Cincinnati, Ohio. Any of these bulletins will be sent upon request.

Rapid Traverse Planers: Cincinnati Hypro Planers, made by the Cincinnati Planer Co., Cincinnati, Ohio, are described in a new catalog that has been issued by this company.

Shaper Progress: An illustrated catalog describing the various types of shapers made by the Cincinnati Shaper Co., Cincinnati, Ohio, and including descriptions of Cincinnati Shapers in use in different kinds of plants.

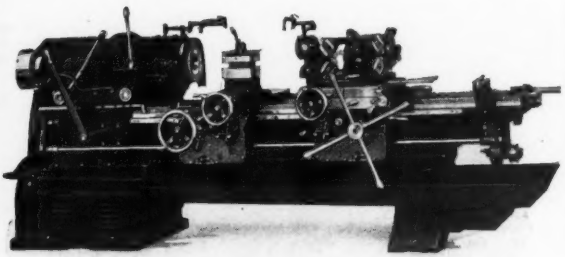
Handbook For Drillers: The Cleveland Twist Drill Co., 1242 E. Forty-ninth St., Cleveland, Ohio, has published a book in which the various parts of the twist drill are described, and which tells how to grind a drill correctly. The troubles that result from incorrect grinding are described and illustrated and several chapters are devoted to the subjects of speeds, feeds, materials, cutting compounds, and so on. Sent free upon request.

Inserted Blade Reamers: A new type of reamer with high speed steel blades, designed to reduce cutting cost and give longer service, is described in a bulletin that will be sent without charge upon application to the Conradson Tool Corporation, 2114 Indiana Ave., Chicago, Ill.

OTHER PUBLICATIONS LISTED ON PAGES 94, 96 AND 98.

No. 3 Acme Heavy Type Universal Turret Lathe with DUO CONTROL

Higher operating efficiency, together with simplified design, makes this Acme Turret Lathe an unequalled producer on all work within range.



DUO CONTROL Turret Lathes Built in These Sizes

No. 1 — Semi- and Full Universal, 2½" capacity.

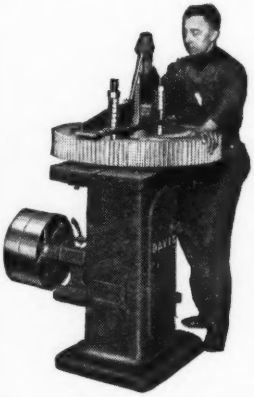
No. 2 — Semi- and Full Universal, 3¼" capacity.

No. 3 — Semi- and Full Universal, 3½" spindle capacity.

17" and 4½" Semi- and Full Universal, 4½" spindle capacity.

THE ACME MACHINE TOOL CO., Cincinnati, Ohio

Two Minutes Setting Up



It takes but two minutes to set up a Davis Keyseater and you are ready for any keyseating job up to 1" wide in steel on hubs up to 12".

Davis Cutters insure maximum efficiency and can be obtained in sizes from 1-16" to 1" in sixteenths and some in thirty-seconds.

Keyseat Cutters and Broaches —High Speed and Carbon Steels in stock for immediate delivery.

DAVIS KEYSEATER COMPANY

250 MILL STREET ROCHESTER, N. Y.

Disc, Expansion and Compression Clutches: The various types of clutches and their uses are discussed in an illustrated booklet that is issued by The Conway Clutch Co., 1959 West Sixth Street, Cincinnati, Ohio.

Cushman Chucks: A series of bulletins has been issued by The Cushman Chuck Co., 805 Windsor St., Hartford, Conn., describing the lathe, screw machine, boring mill, drill press and other chucks made by this firm. Sent free upon request.

Die Makers' Supplies: A complete line of die sets, leader pins, bushings, and other die makers' supplies are described in a book that is issued by the Danly Machine Specialties, Inc., 2104 South 52nd Avenue, Chicago, Ill. Sent free upon request.

Davis Keyseaters: Recent developments in keyseating methods are discussed in a bulletin that also describes the keyseaters made by the Davis Keyseater Company, 250 Mill St., Rochester, N. Y. Copy free upon request.

Grinding Wheel Dressers: All of the different types of grinding wheel dressers made by the Desmond-Stephan Mfg. Co., Urbana, Ohio, including Desmond-Huntington, Desmond-Sherman, Zig-Zag, Diamo-Carbo, and diamond dressers, are described and illustrated in a catalog that has been published by the firm mentioned. Free upon request.

Quantity Drilling: A semi-automatic multiple spindle drilling machine which is designed to produce the maximum of drilled holes in medium or small parts, is described in a pamphlet that is published by the Detroit Machine Tool Co., 5055 Woodward Ave., Detroit, Michigan. Sent free upon request.

Cut Your Cutter Costs: How you can cut your cutter costs in half and increase the efficiency of the tools is told in a bulletin that will be sent free upon application to the Eastern Cutter Salvage Corp'n., 43-45 Freeman St., Newark, N. J.

High Speed Tapping Methods are described in a booklet that is issued by the Eastern Tube & Tool Co., 596 Johnson Ave., Brooklyn, N. Y. The booklet also describes in detail the tapping machines and attachments made by this company.

Interchangeable High Production Tools: Catalog No. 28, issued free by the Eclipse Interchangeable Counterbore Co., 7410 St. Aubin St., Detroit, Michigan, describes and illustrates the interchangeable counterbores, spot facers, end form cutters, and other end cutting tools made by this firm.

Precision Measuring Instruments: The latest types and models of dial indicators, thread lead test gages, pitch gages, thickness gages, dial comparators, and other precision measuring instruments marketed by the Federal Products Corporation, Providence, R. I., are described and illustrated in a book that will be sent free upon application to this firm.

Silent, Self-Lubricating Gears for use in all kinds of machines are described in a booklet that can be had upon application to Fibroc Insulation Company, Valparaiso, Indiana.

Formica Silent Composition Gears: A booklet telling about the uses and advantages of Formica Silent Shock Absorbing Gears, and containing a considerable amount of valuable data with rules and tables for laying out, cutting and using gears. Sent free by Formica Insulation Co., 4632 Spring Grove Avenue, Cincinnati, Ohio.

Fosdick Drills: This publication gives details as to the design and construction of Fosdick Radial, Upright, and Sensitive Drills. Published by the Fosdick Machine Tool Co., Cincinnati, Ohio.

Quick-Acting Clamp: A bulletin describing the "Rapid" drop-forged steel clamp manufactured by the Fountain Equipment & Mfg. Co., 2025 Elm St., Cincinnati, Ohio, has been issued by this firm.

Modern Grinding Equipment: The complete line of universal tool and cutter grinders, surface grinders, drill grinders, tap grinders, and other grinding machines made by the Gallmeyer & Livingston Co., 336 Straight St., W., Grand Rapids, Michigan, is described in a series of bulletins that have been issued by this firm. Free upon request.

Adjustable Blade Cutters: Hollow mills, facing tools, face mills, milling cutters and other production tools with adjustable, interchangeable blades are described and illustrated in a booklet that is issued free by the Genera Manufacturing Co., 141 N. Water St., Rochester, N. Y.

1500 Good Tools: The 1500 tools of various kinds that are made by the Goodell-Pratt Company, Greenfield, Mass., are described and illustrated in a Tool Handbook that has been issued by this firm. Copy free upon request.

Greaves-Klusman Lathes: A book containing complete descriptions of the latest types of lathes made by this firm has been issued by the Greaves-Klusman Tool Co., Oakley, Cincinnati, Ohio.

Air Is Your Best Helper: Air will operate your presses, chucks, vise jaws, and other tools more efficiently and at less cost. Catalog MS-11, issued by the Hannifin Mfg. Co., 621-631 S. Kolmar Ave., Chicago, Ill., will show you how it is done. Ask for a copy.

Drilling and Grinding Electrically: Catalog M, showing and describing a variety of modern electric portable drills, grinders, and other tools, including floor grinders and buffers, has been issued by The Hisey-Wolf Machine Co., Colerain and Marshall Sts., Cincinnati, Ohio.

"Quick-As-Wink" Buffing Wheels that eliminate all disadvantages of rag-buffs, speed output, do better work, and cut buffing costs to the minimum are described in a bulletin that is issued free by C. B. Hunt & Son, 639 McKinley Ave., Salem, Ohio.

Internal Grinding Equipment: The latest equipment for grinding holes of all sizes, from small wrist pin holes to the holes in locomotive cylinders, is described and illustrated in a booklet that will be sent free by the Hutto Engineering Co., Inc., 542 Lacaste Ave., Detroit, Michigan.

Special Mil-Waukee-Mils of Standard Units: A milling machine of which the base, heads, columns, and other parts are built in standard units, thus enabling the user to order a machine that will be especially adapted for his job, is described and illustrated in Catalog No. 36, issued by the Kearney & Trecker Corporation, Milwaukee, Wis. Free to machine shop executives.

Standardized Jigs and Fixtures: Information concerning standardized jigs and fixtures, also all kinds of special equipment for production, can be had by writing to H. R. Krueger & Co., 439 East Fort St., Detroit, Mich.

Cutter and Tool Grinding: A book that tells how to grind tools and cutters accurately and which also describes and illustrates the different types of LeBlond Universal Tool Room Grinders will be sent free upon request. Address, The R. K. LeBlond Machine Tool Co., Cincinnati, Ohio.

Air-Operated Work-Holding Devices: A booklet showing how air-operated chucks and devices of various kinds can be applied to different kinds of machines to save time and labor has been issued by The Logansport Machine Co., Logansport, Ind.

Rapid-Reading Micrometer: A new type of rapid-reading micrometer, designed to show the reading in numerals, is described in Catalog No. 5, issued by The Lufkin Rule Co., Saginaw, Michigan. The catalog also contains descriptions of the micrometers, calipers, gauges, scales, squares, bevel protractors, and other tools made by this company. Free upon request.

Lamp Guards: The various types and kinds of lamp guards made by the McGill Manufacturing Co., Valparaiso, Ind., for factory use are described in a catalog that will be sent free upon request.

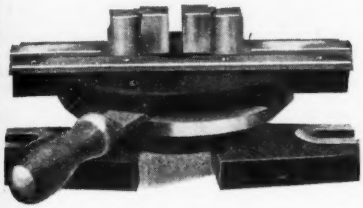
OTHER PUBLICATIONS LISTED ON PAGES 92, 96 AND 98.

One Stroke

and the

WALDEN CAM VISE

Clamps and Centers



any piece, three inches and smaller. Clamping and centering with one quick movement means a real saving in operating costs, and an increase in production.

The Walden Cam Vise is made in two sizes with capacities 0 to 1½″ and 0 to 3″ in diameter. Try it for 30 days, at our expense!

Send the Coupon Now!

FRITZ UHLENHAUT

200 Congress Street Boston, Mass.

FRITZ UHLENHAUT
200 Congress St., Boston, Mass.

Please send me more information about the Walden Cam Vise, and your free trial offer.

Name_____

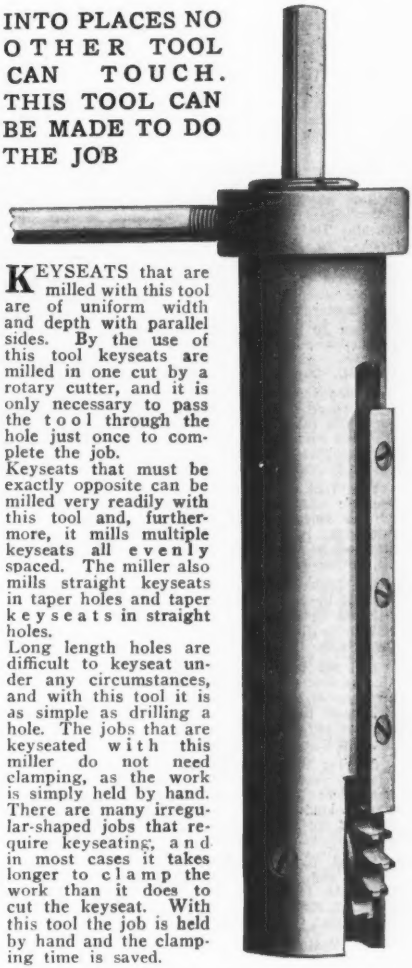
Firm Name_____

Address_____

City_____ **State**_____ 2407

DEPENDABLE Keyseater Reaches

INTO PLACES NO OTHER TOOL CAN TOUCH. THIS TOOL CAN BE MADE TO DO THE JOB



KEYSEATS that are milled with this tool are of uniform width and depth with parallel sides. By the use of this tool keyseats are milled in one cut by a rotary cutter, and it is only necessary to pass the tool through the hole just once to complete the job.

Keyseats that must be exactly opposite can be milled very readily with this tool and, furthermore, it mills multiple keyseats all evenly spaced. The miller also mills straight keyseats in taper holes and taper keyseats in straight holes.

Long length holes are difficult to keyseat under any circumstances, and with this tool it is as simple as drilling a hole. The jobs that are keyseated with this miller do not need clamping, as the work is simply held by hand. There are many irregular-shaped jobs that require keyseating, and in most cases it takes longer to clamp the work than it does to cut the keyseat. With this tool the job is held by hand and the clamping time is saved.

Send for Catalog Q

National Machine Tool Co.

2271 Spring Grove Avenue

CINCINNATI, OHIO, U. S. A.

Time Saving Machine Equipment: How machining time can be reduced to the minimum by the use of Wizard chucks, collets and tap holders, turret tool posts, self-centering steadyrests, and other McCrosky equipment is told in a book that is issued by the McCrosky Tool Corporation, Meadville, Penna. Will be sent without charge.

Accuracy in Internal Grinding: The latest methods of producing accurately-ground holes are described in a booklet which also describes and illustrates the internal grinders made by the Micro Machine Co., Bettendorf, Iowa. Sent free upon request.

Set-up Time Reduced on Drill Presses: How set-up time on drill presses can be reduced by the use of the "Combination Drill Table and Vise," made by the Modern Machine Tool Company, of Jackson, Mich., is told in a bulletin issued by this company. Sent free upon request.

Roller Bearing Radial Drills: The application of Timken roller bearings in the design of modern radial drilling machines is discussed in a bulletin describing "Mor"-Speed Radial Drills, published by the Morris Machine Tool Co., Cincinnati, Ohio.

"The 'Hole' Story in One Word" is the title of a publication that has been issued by The National Automatic Tool Co., Richmond, Ind. The book gives details as to construction and uses of "Natco" multiple drilling and tapping machines.

"How To Properly Grind Broaches" is the title of an instructive chart which will be sent free to users of broaches. Address The National Broach Company, 5 N. June St., Dayton, Ohio.

Milling Internal Keyways: A simple method of milling keyways in gears, wheel hubs, and other similar parts with the aid of a drill press and a special tool is explained in a booklet that is published by the National Machine Tool Co., 2271 Spring Grove Ave., Cincinnati, Ohio.

Save Time with Expanding Mandrels: How expanding mandrels will solve the problem of turning pieces with odd-size holes, and will increase production on duplicate work, is told in a folder that will be sent free upon request by W. H. Nicholson & Son, 136 Oregon St., Wilkes-Barre, Pa.

Live Centers: The complete line of live centers manufactured by Nielsen, Inc., of Lawton, Mich., are fully described in a bulletin issued by this company. This bulletin is illustrated with photographs and blueprints of the Nielsen Center. Mailed free upon request.

Ball and Roller Bearing Data Sheets: A complete set of data sheets showing all the dimensions and loads at given speeds, and giving instructions for mounting precision ball bearing and Hoffmann roller bearings, can be obtained without charge by addressing the Norma-Hoffmann Bearings Corporation, Stamford, Conn.

Grinding Wheel Information: A booklet which tells how grinding wheels are made and graded, and which give instructions for mounting wheels, operating speeds for different kinds of work, instructions for truing and dressing, and other information has been issued by the Norton Company, Worcester, Mass. Sent free upon request.

Correct Cutter Grinding: How cutter costs can be reduced and more production per grind of cutter obtained is told in Booklet "E." published by The Oesterlein Machine Co., 3319 Colerain Ave., Cincinnati, Ohio. Sent free upon request.

Die Making Machines: How dies, templates, gages, etc., can be sawed out, filed, and lapped easily and accurately on Oliver die making machines is fully described in a bulletin issued by the Oliver Instrument Company, 1430 Maumee Street, Adrian, Mich. Mailed upon request.

Self-Tapping Sheet Metal Screws: Screws which are threaded and hardened in such a manner as to enable them to cut their own threads as they are screwed into sheet metal assemblies are described in a folder which is published by the Parker-Kalon Corporation, 192-198 Varick St,. New York City., N. Y. Sent free upon request.

Tapping Devices, Quick-Change Chucks, Stud-Setting Tools and Bench Tappers: A catalog describing the various types and kinds of tapping, drilling, and stud-setting devices manufactured by the Procunier Safety Chuck Company, 12 South Clinton Street, Chicago, Ill. can be obtained without charge by addressing this company. The catalog also tells the part that Procunier tools play in obtaining greater accuracy and less tap breakage.

Engine, Turret, and Gap Lathes are described in a series of bulletins that have been issued by The Ryder-Larmon Co., 2935 Spring Grove Ave., Cincinnati, Ohio.

Pullmore Industrial Clutch: A multiple disc clutch made in two types, to run in oil or dry, and which is so built that it can be operated at high speeds, is illustrated and described in a folder that will be sent free by the Rockford Drilling Machine Company, Rockford, Ill.

Automatic Lubrication: Individually motor-driven pumps that keep the work flooded with lubricant are described in a booklet that has been published by the Ruthman Machinery Co., Front and Pike Sts., Cincinnati, Ohio.

Safety Grinding Wheels: The complete line of grinding wheels made by the Safety Grinding Wheel & Machine Co., Springfield, Ohio, is described in Catalog No. 11, which is issued by this firm. The book also contains instructions for operating grinding wheels, tables of grinding wheel speeds, pulley calculations, and other information for the user of grinding wheels.

Saving Time With Small Tools: A line of time-saving small tools, including "Use-'Em-Up" drill sleeves, "Wonder" chucks, collets, cutters, reamers and tap holders, counterbores, spotfacers, and other tools is described in Catalog 36, issued by Scully-Jones & Co., 1909 S. Rockwell St., Chicago, Ill.

Equipment For the Shop: Vises for the bench, drill press, milling machine or shaper; angle plates; adjustable clamps, jacks and other tools for the machine shop, are described and illustrated in a booklet that is published by the Sheldon Machine Co., 3253-55 Cottage Grove Ave., Chicago, Il. Copy free upon request.

"Chucks and Their Uses" is the name of a book which contains a full description of the different kinds of chucks and suggestions for the proper care of chucks, and tells how chucks should be fitted to lathes. It also contains a number of suggestions for general shop practice. Sent free upon application by The Skinner Chuck Co., New Britain, Conn.

Shaping with Modern Equipment: The Smith & Mills Company, 2889-91 Spring Grove Avenue, Cincinnati, Ohio, has issued a booklet which describes and illustrates the line of modern shaping equipment made by this firm. Copy free upon request.

Electric Drilling and Grinding Equipment: A booklet that is issued by The Standard Electric Tool Co., 1903 West Eighth St., Cincinnati, Ohio, tells how time can be saved, better work done, and the efficiency of the shop improved by the use of electrically-driven drilling and grinding equipment. Free upon request.

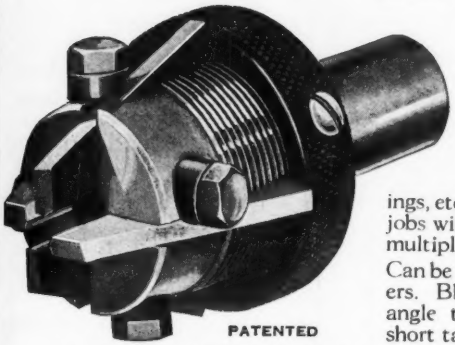
Engineering and Manufacturing Service: A complete engineering and manufacturing service for manufacturers who are not equipped to handle all of their own designing, experimental, or production work is described with illustrations of the equipment available, in a bulletin that is issued by The Steel Products Engineering Co., Springfield, Ohio.

Cutting and Grinding Facts: A discussion of cutting oils and lubricants, together with descriptions and illustrations of various kinds of jobs upon which cutting oils are used, is contained in a booklet that is issued by the Sun Oil Company, Finance Building, Pittsburgh, Pa. Free upon request.

OTHER PUBLICATIONS LISTED ON PAGES 92, 94 AND 98.

Genesee Adjustable Hollow Mill

Made in 7 different styles



PATENTED

Has adjustable, replaceable blades and can be replaced at nominal cost, making it unnecessary to continually buy new tools.

The ideal tool for finishing your forgings, castings, etc. Do your several operation jobs with Genesee inserted blades multiple operation tools.

Can be fitted with drills and reamers. Blades can be ground any angle to point work and turn short tapers.

A Genesee Adjustable Hollow Mill can be made for every job

WRITE FOR CATALOGUE

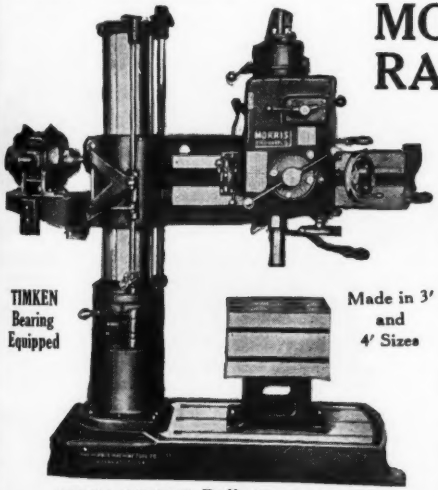
GENESEE MANUFACTURING CO., Inc.

ROCHESTER, NEW YORK

SIX SAFETY FEATURES PROTECT

MORRIS "MOR-SPEED" RADIAL DRILLS

From Damage



TIMKEN Bearing Equipped

Made in 3' and 4' Sizes

Single Lever Control for clamping, elevating and lowering the arm.

Safety Arm Stop at top and bottom of column.

Friction in Feed Train protects the machine from tool jamming in the work.

Automatic Safety Feed Trip throws out feed clutch automatically at top and bottom limit of spindle travel.

Dial Depth Gauge can be set quickly, and trips feed at any predetermined depth.

Positive Forced Feed Lubrication to the head makes oiling safe and sure.

"MOR-SPEED" Bulletin on request

The MORRIS MACHINE TOOL Co.
Court and Harriet Sts., Cincinnati, O.
Pratt & Whitney Company
Sales Representatives

Rigidmilling Principles and Practice: A book that shows how the Rigidmil can be adapted to various kinds of usual and unusual milling operations, and which describes in detail the work that can be handled by this machine has been issued by the Sundstrand Machine Tool Co., Rockford, Ill. Copy free upon request.

Save Cutting Oil: How cutting oil can be separated from chips and thus reclaimed by the use of a centrifugal chip "wringer," is told in a bulletin that is issued free by the Tolhurst Machine Works, Troy, N. Y.

Chuck With Air: How time and labor can be saved by the use of air-operated chucks, cylinders, and other equipment is told in a book which describes "Hopkins" Air-Operated Equipment. Published by The Tomkins-Johnson Company, 620 N. Mechanic St., Jackson, Mich. Sent free upon request.

A Simplified and Improved Drive Control for Machinery: Two distinct types of plate clutches that have proved successful highly in the driving mechanism of machine tools are described and illustrated in a bulletin that will be sent free by the Twin Disc Clutch Company, Racine, Wis.

Walden Cam Vise: A vise that centers and clamps the work with one stroke of a hand lever, and which can be used as a quick-action jig for pieces of any shape, is described in a circular that will be sent free by Fritz Uhlenhaut, 200 Congress St., Boston, Mass.

Multiple Drilling With a Single-Spindle Drill: Methods by which multiple drilling may be done on a single-spindle drill, using multiple spindle drill heads, are discussed in a bulletin that is issued by The United States Drill Head Co., 1954 Riverside Drive, Cincinnati.

Electrically-Driven Portable Tools: The "U. S." line of electric drills, die grinders, electric screw drivers, surface grinders, tool post grinders, and bench and floor grinders is described in Catalog No. 24, which has been published by The United States Electrical Tool Co., 2471 W. Sixth St., Cincinnati, Ohio.

"The best tapped holes we ever got were with APEX chucks and *free floating collets.*"

Tap is free to float and follow the hole.

Positive and friction drive.

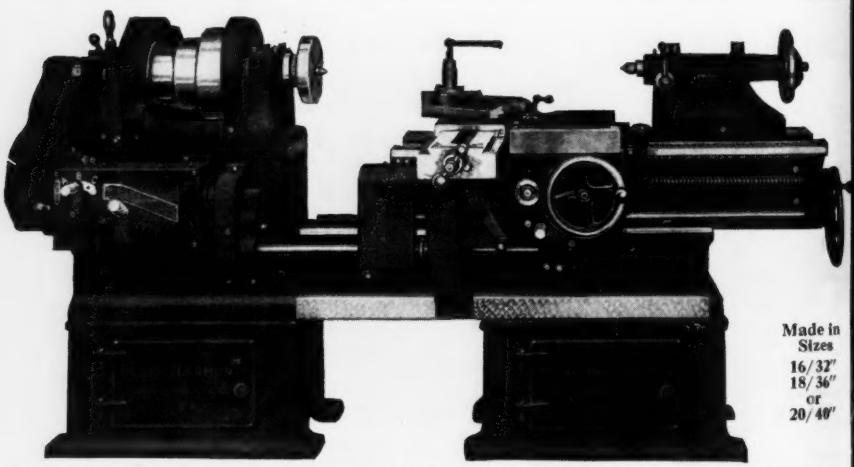
Quick change chucks.

Single and multiple spindle.

Full and semi floating tool holders.

Write for Catalogue

The APEX MACHINE CO.
305 Davis Ave. Dayton, Ohio



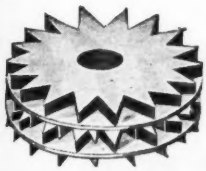
Made in Sizes
16/32"
18/36"
or
20/40"

Rahn-Larmon 18/36" Extension Bed Gap Lathe

A lathe for large or small swing work, ready at all times. Requires no extra rigging up. Takes different distances between centers.

Belt driven or with nine speed all geared motor driven head. Tell us what your requirements are and let us quote you.

THE RAHN-LARMON CO. 2935 Spring Grove Ave., Cincinnati, Ohio



The **DESMOND** "Long Tooth"

No. O Tool Steel Cutter

These Tool Steel Cutters have 20% longer teeth and will outlast two or more sets of any ordinary No. O Cutters on the market. If you are interested in cutting your wheel dressing costs, write us for a sample of these cutters.

The DESMOND-STEPHAN MFG. CO., URBANA, OHIO

No Time Wasted

Adjusting the

RAPID

Drop Forged Steel

CLAMP

Just pull the trigger, set the ram, and give the screw a turn to obtain the necessary pressure. Unequalled for speed and rigidity. Made in three sizes—4 in., 6 in., and 9 in.

EVERY CLAMP WARRANTED

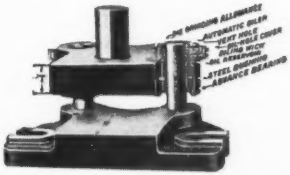
FOUNTAIN EQT. & MFG. CO.

2025-9 Elm Street Cincinnati, Ohio

BAUMBACH

Automatically Oiled

DIE SETS



Standardized die sets, embodying many exclusive features, and a listing of 70,000 stock sizes afford a service that is unsurpassed.

Your Inquiries Solicited
Send for New 120 Page Catalog

E. A. Baumbach Mfg. Co.

1806 S. Kilbourne Ave. Chicago, Ill.

FEDERAL **DIAL INDICATORS**

Comparators	Pitch Diameter Gauges	Tap Comparator Gauges
Amplifying Gauges	Cylinder Gauges	Gear Tooth Comparators
Thickness Gauges	Paper Gauges	Cutter Testing Gauges
Depth Gauges	Fabric Gauges	Internal and External Grinding Gauges
Thread Lead Gauges	Rubber Gauges	

Federal Products Corporation, Providence, R. I.

Western Branch: 7338 WOODWARD AVE., DETROIT, MICH.

Riff-Raff Ravings

By GEO. ALEXANDER MANN
Raver-in-Chief

Explanation Sublime

"Did you miss the train, sir?"
He replied with indignation:
"No; I didn't like it,
So I chased it out the station."

Then there's the sap who seems to think wives are like newspapers—if he hasn't got one of his own he'll pick up his neighbor's.

Sunk Is Right

Friend neighbor is puttin' in a sunken garden—but until the chickens next door get busy he won't realize how sunk it is.

Ask Any Ol' P. A.

It's sad when a peddler realizes that he's no salesman—but it's sadder when he don't.

Oh, Mercy!

The maid said, "The Lady's
In her bath, Mr. Hope."
"Oh," says he, "Tha's all right,
I'm a-sellin' soap."

We read, "The whaling business is a thing of the past." Yeh, the behavior of our young folks is proof enough.

When the sympathy-seeking sa complains to you that his wife do understand him—congratulate him.

You Know Him

About a certain golfer,
This fact we'd like to stencil.
We find he's got no club
As deadly as his pencil.

The meek that inherit the earth wi be meek only until they inherit it.

So Sez Liz

I always sit out the dances
With Lemuel an' Pete;
I'd rather be on their laps,
Than have them on my feet.

Did you ever think of the poor dev ils waiting for their coin so that M and Mrs. Four Flush could put up front?

Can Yuh Imagine Ut?

As some scientists insist, the da may come when men an' wimmin wi change places—but it's dem hard t imagine a man gettin' anywhere wit pleas for alimony by crossin' his leg in the court-room an' showin' th judge his garters.